

ABSTRACT

JONES, ZACHARY GLEN. Screening of Maize Exotic Germplasm for Dominant Gametophyte Factors and Resistance to the Male-Only Variant of *Gametophyte Factor 1* (*Gal-m*). (Under the direction of Major Goodman).

The rapid increase in the number of acres planted to genetically modified (GM) corn has made production of non-GM types increasingly difficult due to corn's wind-pollinated nature and strict contamination standards. To overcome this problem, specialty producers, especially organic producers, have an interest in hybrids with selective pollinating systems. The previously identified alleles conferring this selective action have been problematic to work with from a production standpoint, leaving a gap between identification and utilization of these systems. In this study, we first screened exotic maize germplasm for dominant gametophyte factors (DGFs) conferring selective pollination phenotypes. From this screen, we identified several lines that putatively contain DGFs and were able to demonstrate that 1) the ability to backcross these factors into adapted material is variable, but that some factors appear to be successfully introgressed, 2) that topcrosses of lines putatively containing DGFs have sufficient yield to be viable economically, as well as performing competitively with the available commercial alternative with a similar system and 3) that *Tcb-1* homozygous lines exist that overcome the yield drag associated with these alleles. We believe these DGF lines have potential to be a viable alternative to current specialty production protocols, as well as being a valuable tool in protecting a producer's right to choose their own production system. The *gametophyte factor 1* locus, which confers selective pollination, has three known alleles: *gal*, which is the inactive allele, *Gal-s*, which confers selective pollination through a pollen-matching system, and *Gal-m*, which is successfully pollinates *Gal-s* silks but does not

contain the female barrier. The *Gal-m* allele overcomes *Gal-s* alleles, making the long-term use of even dominant *Gal-s* hybrids susceptible to failure if *Gal-m* is present in neighboring fields. The *Gal-m* allele has been shown to be abundant in Mexican commercial hybrids, and has been reported in American commercial hybrids as well. In this study, we examine lines derived from maize accessions for resistance to *Gal-m* pollination and report the presence of *Gal-m* resistance for the first time. The resistance appears heritable, and resistance to *Gal-m* appears to be independent of *gal* resistance, although further examination is necessary. We also report the presence of a small number of lines with resistance to both *gal* and *Gal-m*, which we propose to be useful for breeding purposes. Further screening of maize accessions may reveal better DGFs and additional sources of resistance to *Gal-m*.

© Copyright 2015 Zachary Jones

All Rights Reserved

Screening of Maize Exotic Germplasm for Dominant Gametophyte Factors and Resistance to
the Male-Only Variant of *Gametophyte Factor 1 (Ga1-m)*

by
Zachary Glen Jones

A thesis submitted to the Graduate Faculty of
North Carolina State University
in partial fulfillment of the
requirements for the degree of
Master of Science

Crop Science

Raleigh, North Carolina

2015

APPROVED BY:

Major M. Goodman
Committee Chair

Matthew D. Krakowsky

Chris Reberg-Horton

David A. Dickey

DEDICATION

To my father for teaching me about the world, to my mother for teaching me to love its people, and to Kathryn for exploring it all with me.

BIOGRAPHY

Zachary Jones was born in 1992 to Mike and Tammy Jones of Spring Garden, Alabama. Growing up the son of a soldier provided him with many opportunities to see the world through a different perspective, and these insights lead to desire to make a positive impact on the world. In high school, Zach connected this passion with focus through membership in the National FFA Origination. Through FFA, he discovered his true passion for agriculture and service, even serving as the 2008-2009 Alabama State FFA President. Through this experience, he learned about the work of plant breeding and set his sights on making that his profession. Upon graduation from Spring Garden High School in 2010, he attended Auburn University to complete a degree in Agronomy and Soils-Science.

While at Auburn, Zach began crafting his academics to best prepare himself for a career in plant breeding. He was an officer in the Agronomy Club, as well as president of his social fraternity. He had the good fortune of having several good advisors, especially Dr. David Weaver and Dr. Narendra Singh who provided him with valuable insights and encouragement. He finished his degree in three years, graduating Cum Laude in May 2013. Zach moved to Raleigh, North Carolina in May 2013 to begin work on a Master's thesis focusing on identification and utilization of dominant gametophyte factors for organic corn production. After graduation, he will continue on in the Goodman lab for a Ph.D., hoping to further unravel the complexities of pollen isolating factors in maize.

ACKNOWLEDGMENTS

There are innumerable people to who I am grateful for their support over the years. First and foremost, I would like to thank my parents for their endless support of my dreams, constant support of my goals, and the occasional reminder that agriculture is about people as much as it is about crops. I would also like to thank all of my friends at home for your constant belief in me, and endless support of my studies. Very special thanks to my agriscience teacher, Mr. Dennis Tierce, for helping me discover my passion for agriculture, my confidence as a leader, and for being like a second father to me during my time in your program. I am endlessly grateful for your belief in me as a seventh-grader.

A big thank you to Dr. David Weaver for allowing me to get my feet wet in plant breeding, as well as piles of good advice. I would also like to thank Dr. Narendra Singh for his wonderful advice, great perspective, and help during my studies at Auburn. Special “thank yous” to Drs. Elizabeth Guertal, Scott McElroy, and Bob Locy for the opportunities you provided for me and for your support during my time at Auburn.

I would like to thank my advisors, Dr. Major Goodman and Dr. Matt Krakowsky for their help and guidance during my time at N.C. State. Thank you to my committee members, Dr. Chris Rebreg-Horton and Dr. David Dickey for advice and assistance in my research. Also to our three wonderful technicians Bill Hill, Wayne Dillard and Dale Dowden for assistance in the field, and for the valuable insights about what it really takes to be a great plant breeder. Special thanks to my friends at NC State for all of their help, especially Drs. Oliver Ott and Jill Lennon.

TABLE OF CONTENTS

LIST OF TABLES	vi
LIST OF FIGURES	xxvii
Chapter I: Literature Review	1
Literature Cited	13
Chapter II : Evaluation of Tropical Maize Germplasm for Dominant Gametophyte Factors.....	15
Materials and Methods.....	20
<i>Plant Material</i>	<i>20</i>
<i>Field Design, Material Development and Evaluation</i>	<i>21</i>
Results	24
Discussion.....	179
Literature Cited	186
Chapter III : Screening of Maize Germplasm for Alleles Conferring Resistance to the Male-Only Variant of <i>gametophyte factor 1 (Ga1-m)</i> Pollination	188
Materials and Methods.....	191
<i>Plant Material</i>	<i>191</i>
<i>Material Development.....</i>	<i>192</i>
<i>Experimental Conditions</i>	<i>193</i>
Results	194
Discussion.....	243
Literature Cited	252
APPENDICES.....	253
APPENDIX I	254
APPENDIX II.....	271
APPENDIX III	276

LIST OF TABLES

CHAPTER II

Table 1. Accessions evaluated with Plant Introduction numbers	20
Table 2. Results for <i>gal</i> isolation block evaluation for 9525 from Jalisco 78	25
Table 3. Results of <i>gal</i> pollination evaluation for 9526 from Jalisco 78	26
Table 4. Results of <i>gal</i> pollination evaluation for 9526 from Jalisco 78	26
Table 5. Results of <i>gal</i> isolation block evaluation of 9526 from Jalisco 78	28
Table 6. Results of <i>gal</i> pollination evaluation of 1161 derived crosses from Jalisco 78.....	29
Table 7. Results of <i>gal</i> isolation block evaluation on a 1212-1 line from Jalisco 78	30
Table 8. Results of <i>gal</i> isolation evaluation on 1222-3 derived crosses from Jalisco 78	31
Table 9. Results of <i>gal</i> evaluation on 1222-2 and 1222-3 derived crosses from Jalisco 78 ...	32
Table 10. Results of <i>gal</i> evaluation of HBA1x1222-2 derived crosses from Jalisco 78	32
Table 11. Results of <i>gal</i> evaluation of LH182x1222-2 derived crosses from Jalisco 78	33
Table 12. Results of <i>gal</i> isolation evaluation of 1223-10 from Jalisco 78.....	34
Table 13. Results of <i>gal</i> (and <i>Gal-s</i> for NC296 and NC522 crosses) evaluation of 1223 derived crosses from Jalisco 78	35
Table 14. Results of <i>gal</i> isolation evaluation of 1226-derived lines from Jalisco 78	36
Table 15. Results of <i>gal</i> or <i>Gal-s</i> evaluation of 1226 derived crosses from Jalisco 78	37
Table 16. Results of <i>gal</i> evaluation of 3801 from Jalisco 78.....	38
Table 17. Results of <i>gal</i> isolation evaluation of 3801 from Jalisco 78.....	39
Table 18. Results of <i>gal</i> isolation evaluation of 1179-2 derived lines from Jalisco 78	40
Table 19. Results of <i>gal</i> evaluation of 1179-2 from Jalisco 78	40
Table 20. Results of <i>gal</i> isolation evaluation of 1161-5 derived lines from Jalisco 78.....	41
Table 21. Results of <i>gal</i> isolation evaluation of 1214-5 derived lines from Jalisco 78.....	42

Table 22. Results of <i>gal</i> evaluation of 1214-5 derived lines from Jalisco 78.....	43
Table 23. Results of <i>gal</i> isolation evaluation of 1222-2 derived lines from Jalisco 78	44
Table 24. Results of <i>gal</i> evaluation of 1223 derived lines from Jalisco 78	44
Table 25. Results of <i>gal</i> isolation evaluation of 1223-1(8349-8) F ₂ S ₁ lines from Jalisco 78.....	45
Table 26. Results of additional <i>gal</i> evaluation of 1223-1(8349-9) F ₂ S ₁ lines from Jalisco 78.....	46
Table 27. Results of <i>gal</i> evaluation of 1223-2 F ₂ S ₁ lines from Jalisco 78.....	46
Table 28. Results of <i>gal</i> evaluation of 1223-9 F ₂ S ₁ lines from Jalisco 78.....	47
Table 29. Results of <i>gal</i> isolation block evaluation of 1226 F ₂ S ₁ lines from Jalisco 78	48
Table 30. Results of <i>gal</i> nursery evaluation of 1226-4 F ₂ S ₁ lines from Jalisco 78.....	49
Table 31. Results of <i>gal</i> nursery evaluation of 1226-9(8362-4) F ₂ S ₁ lines from Jalisco 78.....	50
Table 32. Results of additional <i>gal</i> nursery evaluation of 1226-9(8362-5) F ₂ S ₁ lines from Jalisco 78.....	51
Table 33. Results of <i>gal</i> nursery evaluation of PHN46 and PHP38x1222-2(298-i and j) F _{3:1} crosses from Jalisco 78.....	52
Table 34. Results of <i>gal</i> nursery evaluation of 1222-2(299-a) F _{3:1} crosses from Jalisco 78.....	53
Table 35. Results of <i>gal</i> nursery evaluation of 1222-2(300-a) F _{3:1} crosses from Jalisco 78.....	54
Table 36. Results of <i>gal</i> nursery evaluation of NC296x1222-2 F _{3:1} crosses from Jalisco 78.....	54
Table 37. Results of <i>gal</i> nursery evaluation of 1223-10 BC ₂ crosses from Jalisco 78	55
Table 38. Results of <i>gal</i> nursery evaluation of 1226-5 BC ₂ crosses from Jalisco 78	56
Table 39. Results of <i>gal</i> isolation block evaluation of Jalisco 300 F ₂ lines.....	58
Table 40. Results of <i>gal</i> nursery evaluation of 1228-2 F ₂ S ₁ lines from Jalisco 300.....	58

Table 41. Results of <i>gal</i> isolation block evaluation of 1228-2 F ₂ lines from Jalisco 300.....	59
Table 42. Results of <i>gal</i> isolation block evaluation of 1231-4 F ₂ lines from Jalisco 300.....	60
Table 43. Results of <i>gal</i> nursery evaluation of NC296x1228-2 F _{2:1} crosses from Jalisco 300.....	60
Table 44. Results of <i>gal</i> nursery evaluation of 1228-2(8081-a) F _{2:1} crosses from Jalisco 300.....	61
Table 45. Results of <i>gal</i> nursery evaluation of 1228-2(8081-b) F _{2:1} crosses from Jalisco 300.....	62
Table 46. Results of <i>gal</i> nursery evaluation of 1162-9 F ₁ crosses from Jalisco 304	63
Table 47. Results of <i>gal</i> isolation block evaluation of an 1162-9 F ₂ line from Jalisco 304.....	64
Table 48. Results of <i>gal</i> nursery evaluation of 1162-9 BC ₂ crosses from Jalisco 304	65
Table 49. Results of <i>gal</i> isolation block evaluation of 9537 and 9538 F ₁ crosses from Zacatecas 40.....	66
Table 50. Results of <i>gal</i> nursery evaluation of 9537 F ₁ crosses from Zacatecas 40.....	67
Table 51. Results of <i>gal</i> nursery evaluation of 9538 F ₁ crosses from Zacatecas 40.....	69
Table 52. Results of <i>gal</i> nursery evaluation of 9537 F ₁ crosses from Zacatecas 40.....	70
Table 53. Results of <i>gal</i> nursery evaluation of 9538-5 and 9538-6 F _{2:1} crosses from Zacatecas 40.....	71
Table 54. Results of <i>gal</i> nursery evaluation of 9538-8(245-6) F _{2:1} crosses from Zacatecas 40.....	72
Table 55. Results of <i>gal</i> nursery evaluation of 9537-1(264-1) F _{2:1} crosses from Zacatecas 40.....	73
Table 56. Results of <i>gal</i> nursery evaluation of 9538-3(8600-5) BC ₂ lines from Zacatecas 40.....	74
Table 57. Results of <i>gal</i> nursery evaluation of 9538-9(8601-2) BC ₂ lines from Zacatecas 40.....	75

Table 58. Results of <i>gal</i> nursery evaluation of 9537-2(8576-2) pseudo-BC ₂ lines from Zacatecas 40.....	75
Table 59. Results of <i>gal</i> nursery evaluation of 9537-3 and 9537-5 pseudo-BC ₂ lines from Zacatecas 40.....	76
Table 60. Results of <i>gal</i> nursery evaluation of 1349-5 BC ₁ lines in two backgrounds from Zacatecas 182.....	78
Table 61. Results of <i>gal</i> nursery evaluation of 1349-9 F ₁ lines from Zacatecas 182	78
Table 62. Results of <i>gal</i> nursery evaluation of 1411-3 F ₁ lines from Zacatecas 182	79
Table 63. Results of <i>gal</i> nursery evaluation of 1411 derived F ₁ lines from Zacatecas 182.....	80
Table 64. Results of <i>gal</i> nursery evaluation of 1411-11 BC ₁ lines from Zacatecas 182	80
Table 65. Results of <i>gal</i> nursery evaluation of 1411-13 BC ₁ lines from Zacatecas 182	81
Table 66. Results of <i>gal</i> nursery evaluation of 1411-14 F ₁ lines from Zacatecas 182	82
Table 67. Results of additional <i>gal</i> nursery evaluation of 1411-14 F ₁ lines from Zacatecas 182.....	82
Table 68. Results of <i>gal</i> isolation block evaluation of 9539 and 9540 F ₁ lines from Zacatecas 182.....	83
Table 69. Results of <i>gal</i> nursery evaluation of NC368x9539 F ₁ lines from Zacatecas 182 ...	84
Table 70. Results of <i>gal</i> nursery evaluation of 9539-3 and 9539-7 F ₁ lines from Zacatecas 182.....	85
Table 71. Results of <i>gal</i> nursery evaluation of 9539-11 F ₁ lines from Zacatecas 182	86
Table 72. Results of <i>gal</i> nursery evaluation of LH132x9540 F ₁ lines from Zacatecas 182.....	87
Table 73. Results of <i>gal</i> nursery evaluation of 9540 F ₁ lines from Zacatecas 182.....	88
Table 74 Results of <i>gal</i> nursery evaluation of HBA1x(LH51x9540-10) F ₂ lines from Zacatecas 182.....	89
Table 75. Results of <i>gal</i> isolation block evaluation of 3807 F ₂ lines from Zacatecas 182	90
Table 76. Results of <i>gal</i> nursery evaluation of 3807 F ₂ lines from Zacatecas 182.....	91

Table 77. Results of <i>gal</i> nursery evaluation of 1349-5 BC ₁ lines from Zacatecas 182	92
Table 78. Results of <i>gal</i> nursery evaluation of 1411-9a pseudo-BC ₁ lines from Zacatecas 182.....	93
Table 79. Results of <i>gal</i> nursery evaluation of 1411-11 BC ₁ lines from Zacatecas 182	93
Table 80. Results of <i>gal</i> nursery evaluation of 9539-4 BC ₁ crosses from Zacatecas 182	94
Table 81. Results of <i>gal</i> nursery evaluation of 9539-5 BC ₁ lines from Zacatecas 182	95
Table 82. Results of <i>gal</i> nursery evaluation of 9539-7 BC ₁ crosses from Zacatecas 182	96
Table 83. Results of <i>gal</i> nursery evaluation of 9540-2 BC ₁ crosses from Zacatecas 182	96
Table 84. Results of <i>gal</i> nursery evaluation of 9539-9 BC ₁ crosses from Zacatecas 182	97
Table 85. Results of <i>gal</i> nursery evaluation of 9539-10 BC ₁ crosses from Zacatecas 182	97
Table 86. Results of <i>gal</i> nursery evaluation of 9540-3 BC ₁ crosses from Zacatecas 182	98
Table 87. Results of <i>gal</i> isolation block evaluation of 9529 F ₁ crosses from Guanajuato 100	99
Table 88. Results of <i>gal</i> nursery evaluation of LH132x9529 F ₁ crosses from Guanajuato 100	100
Table 89. Results of <i>gal</i> nursery evaluation of NC368x9529 F ₁ crosses from Guanajuato 100	101
Table 90. Results of <i>gal</i> nursery evaluation of 9529-9 F ₁ crosses from Guanajuato 100.....	102
Table 91. Results of <i>gal</i> nursery evaluation of 9529-13 F ₁ crosses from Guanajuato 100...102	
Table 92. Results of <i>gal</i> nursery evaluation of 2014 LH132x9530 F ₁ crosses from Guanajuato 100	103
Table 93. Results of <i>gal</i> nursery evaluation of 2013 LH132x9530 F ₁ crosses from Guanajuato 100	104
Table 94. Results of <i>gal</i> nursery evaluation of 9530-8 F ₁ crosses from Guanajuato 100.....	105
Table 95. Results of <i>gal</i> nursery evaluation of 9529-1 BC ₁ crosses from Guanajuato 100	105

Table 96. Results of <i>gal</i> nursery evaluation of 9529-2 BC ₂ crosses from Guanajuato 100	106
Table 97. Results of <i>gal</i> nursery evaluation of 9529-4 pseudo-BC ₁ crosses from Guanajuato 100	107
Table 98. Results of <i>gal</i> nursery evaluation of 9529-6 pseudo-BC ₁ crosses from Guanajuato 100	107
Table 99. Results of <i>gal</i> nursery evaluation of 9529-8 pseudo-BC ₁ crosses from Guanajuato 100	108
Table 100. Results of <i>gal</i> nursery evaluation of 9530-6 pseudo-BC ₁ crosses from Guanajuato 100	108
Table 101 Results of <i>gal</i> nursery evaluation of 9530-8 pseudo-BC ₁ crosses from Guanajuato 100	109
Table 102. Results of <i>gal</i> isolation block evaluation of 9531 F ₁ crosses from Guanajuato 141	110
Table 103. Results of <i>gal</i> isolation block evaluation of 9532 F ₁ crosses from Guanajuato 141	111
Table 104. Results of <i>gal</i> nursery evaluation of NC368x9531 F ₁ crosses from Guanajuato 141	111
Table 105. Results of <i>gal</i> nursery evaluation of LH132x9531 F ₁ crosses from Guanajuato 141	112
Table 106. Results of <i>gal</i> nursery evaluation of LH51x9531-9 F ₁ crosses from Guanajuato 141	113
Table 107. Results of <i>gal</i> nursery evaluation of 9531-11 F ₁ crosses from Guanajuato 141	114
Table 108. Results of <i>gal</i> nursery evaluation of 9532-2 F ₁ crosses from Guanajuato 141	115
Table 109. Results of <i>gal</i> nursery evaluation of LH132x9532 F ₁ crosses from Guanajuato 141	115
Table 110. Results of <i>gal</i> nursery evaluation of 9532-11 F ₁ crosses from Guanajuato 141	117

Table 111. Results of <i>gal</i> nursery evaluation of 9531-5 pseudo-BC crosses from Guanajuato 141	118
Table 112. Results of <i>gal</i> nursery evaluation of 9531-7 pseudo-BC crosses from Guanajuato 141	119
Table 113. Results of <i>gal</i> nursery evaluation of 9531-8 pseudo-BC crosses from Guanajuato 141	119
Table 114. Results of <i>gal</i> nursery evaluation of 9531-9 BC ₂ crosses from Guanajuato 141	120
Table 115. Results of <i>gal</i> nursery evaluation of 9531-12 BC ₁ crosses from Guanajuato 141	121
Table 116. Results of <i>gal</i> nursery evaluation of 9532-6 pseudo-BC crosses from Guanajuato 141	121
Table 117. Results of <i>gal</i> nursery evaluation of 9532-7 BC crosses from Guanajuato 141	122
Table 118. Results of <i>gal</i> nursery evaluation of 9532-8 pseudo-BC crosses from Guanajuato 141	123
Table 119. Results of <i>gal</i> nursery evaluation of NC320xLH132.9532-10 BC ₁ crosses from Guanajuato 141	123
Table 120. Results of <i>gal</i> nursery evaluation of NC368xLH132.9532-10 BC ₁ crosses from Guanajuato 141	124
Table 121. Results of <i>gal</i> nursery evaluation of 9532-14 pseudo-BC crosses from Guanajuato 141	125
Table 122. Results of additional <i>gal</i> nursery evaluation of 9532-14 pseudo-BC crosses from Guanajuato 141	125
Table 123. Results of <i>gal</i> isolation block evaluation of 9533 F ₁ crosses from Guanajuato 181	126
Table 124. Results of <i>gal</i> isolation block evaluation of 9534 F ₁ crosses from Guanajuato 181	127
Table 125. Results of <i>gal</i> nursery evaluation of LH132x9533 F ₁ crosses from Guanajuato 181	127

Table 126. Results of <i>gal</i> nursery evaluation of LH51x9533-1 F ₁ crosses from Guanajuato 181	129
Table 127. Results of <i>gal</i> nursery evaluation of 9533-2 F ₁ crosses from Guanajuato 181	129
Table 128 Results of <i>gal</i> nursery evaluation of NC368x9533 F ₁ crosses from Guanajuato 181	130
Table 129. Results of <i>gal</i> nursery evaluation of LH132x9534 F ₁ crosses from Guanajuato 181	131
Table 130. Results of <i>gal</i> nursery evaluation of LH132x9534 F ₁ crosses from Guanajuato 181	132
Table 131. Results of <i>gal</i> nursery evaluation of 9534-7 F ₁ crosses from Guanajuato 181	133
Table 132. Results of <i>gal</i> nursery evaluation of 9533-1 BC ₁ crosses from Guanajuato 181	134
Table 133. Results of <i>gal</i> nursery evaluation of 9533-2 pseudo-BC ₁ crosses from Guanajuato 181	135
Table 134 Results of <i>gal</i> nursery evaluation of 9533-6 pseudo-BC ₁ crosses from Guanajuato 181	135
Table 135. Results of <i>gal</i> nursery evaluation of 9533-9 BC ₁ crosses from Guanajuato 181	136
Table 136. Results of <i>gal</i> nursery evaluation of 9533-11 BC ₂ crosses from Guanajuato 181	136
Table 137. Results of <i>gal</i> nursery evaluation of 9534-1 BC ₁ crosses from Guanajuato 181	137
Table 138. Results of <i>gal</i> nursery evaluation of 9534-4 pseudo-BC ₁ crosses from Guanajuato 181	138
Table 139. Results of <i>gal</i> nursery evaluation of 9534-6 pseudo-BC ₂ crosses from Guanajuato 181	138
Table 140. Results of <i>gal</i> nursery evaluation of 9534-9 pseudo-BC ₁ crosses from Guanajuato 181	139

Table 141. Results of <i>gal</i> isolation block evaluation of 9536 F ₁ crosses from Michoacán 412.....	139
Table 142. Results of <i>gal</i> nursery evaluation of LH132x9536 F ₁ crosses from Michoacán 412.....	140
Table 143. Results of <i>gal</i> nursery evaluation of 9058-1 F ₁ crosses from Michoacán 412 ...	141
Table 144. Results of <i>gal</i> nursery evaluation of 9058-2 F ₁ crosses from Michoacán 412 ...	141
Table 145. Results of <i>gal</i> nursery evaluation of 9059-1 F ₁ crosses from Michoacán 412 ...	142
Table 146. Results of <i>gal</i> nursery evaluation of 9059-2 F ₁ crosses from Michoacán 412 ...	143
Table 147. Results of <i>gal</i> nursery evaluation of 9059-3 F ₁ crosses from Michoacán 412 ...	144
Table 148. Results of <i>gal</i> nursery evaluation of 9059-4 F ₁ crosses from Michoacán 412 ...	144
Table 149. Results of <i>gal</i> nursery evaluation of 9059-5 F ₁ crosses from Michoacán 412 ...	145
Table 150. Results of <i>gal</i> nursery evaluation of 9059-6 F ₁ crosses from Michoacán 412 ...	145
Table 151. Results of <i>gal</i> nursery evaluation of 9059-9 F ₁ crosses from Michoacán 412 ...	146
Table 152. Results of <i>gal</i> nursery evaluation of 9536-4 BC ₁ crosses from Michoacán 412.....	147
Table 153. Results of <i>gal</i> isolation block evaluation of 9521 and 9522 F ₁ crosses from Benz 875	147
Table 154. Results of <i>gal</i> isolation block evaluation of 9523 and 9524 F ₁ crosses from Benz 878	148
Table 155. Results of <i>gal</i> nursery evaluation of 9521-8 F ₁ crosses from Benz 875	149
Table 156. Results of <i>gal</i> nursery evaluation of LH132x9522 and LH132x9523 F ₁ crosses from Benz 875	150
Table 157. Results of <i>gal</i> nursery evaluation of NC368x9522-3 F ₁ crosses from Benz 875	151
Table 158. Results of <i>gal</i> nursery evaluation of 9522-2 pseudo-BC ₁ crosses from Benz 875	152
Table 159. Results of <i>gal</i> nursery evaluation of LH51x9528-2 F ₁ crosses from Z07-011 ...	153

Table 160. Results of <i>gal</i> nursery evaluation of LH132x9528-2 F ₁ crosses from Z07-011	153
Table 161. Results of <i>gal</i> nursery evaluation of 9528-4 F ₁ crosses from Z07-011	154
Table 162. Results of <i>gal</i> nursery evaluation of LH132x9528-5 F ₁ crosses from Z07-011	154
Table 163. Results of <i>gal</i> nursery evaluation of LH51x9528-5 F ₁ crosses from Z07-011	155
Table 164. Results of <i>gal</i> nursery evaluation of 9528-6 F ₁ crosses from Z07-011	156
Table 165. Results of <i>gal</i> isolation block evaluation of 9541 F ₁ crosses from Palomero-CHH 148	156
Table 166. Results of <i>gal</i> nursery evaluation of 9541-h F ₁ crosses from Palomero-CHH 148	157
Table 167. Results of <i>gal</i> isolation evaluation of 9541 F ₂ families from Palomero-CHH 148	158
Table 168. Results of <i>gal</i> nursery evaluation of 9541(3809-1) F ₂ families from Palomero-CHH 148	158
Table 169. Results of <i>gal</i> nursery evaluation of 9541(3809-2) F ₂ lines from Palomero-CHH 148	159
Table 170. Results of <i>gal</i> nursery evaluation of 9541(3809-3) F ₂ lines from Palomero-CHH 148	159
Table 171. Results of <i>gal</i> nursery evaluation of 9541(3809-4) F ₂ lines from Palomero-CHH 148	160
Table 172. Results of <i>Gal-s</i> nursery evaluation of <i>Tcbl+Gal-m</i> BC ₁ s with NC464.....	161
Table 173. Results of additional <i>Gal-s</i> nursery evaluation of <i>Tcbl+Gal-m</i> BC ₁ s with NC464.....	162
Table 174. Results of <i>Gal-s</i> nursery evaluation of <i>Tcbl+Gal-m</i> BC ₁ s with NC520.....	162
Table 175. Results of <i>gal</i> nursery evaluation of <i>Tcbl+Gal-m</i> BC ₁ s with 1116-1	163
Table 176. Results of <i>gal</i> nursery evaluation of <i>Tcbl+Gal-m</i> BC ₁ s with 8213-2.....	164

Table 177. Results of additional <i>gal</i> nursery evaluation of <i>Tcb1+Gal-m</i> BC ₁ s with 8213-2	164
Table 178. Results of <i>gal</i> nursery evaluation of <i>Tcb1+Gal-m</i> BC ₃ s with HBA1	165
Table 179. Results of additional <i>gal</i> nursery evaluation of <i>Tcb1+Gal-m</i> (8420-5) BC ₃ s with HBA1	166
Table 180. Results of <i>gal</i> nursery evaluation of <i>Tcb1+Gal-m</i> (8436-2) BC ₃ s with HBA1	166
Table 181. Results of additional <i>gal</i> nursery evaluation of <i>Tcb1+Gal-m</i> (8436-3) BC ₃ s with NC368	167
Table 182. Results of <i>gal</i> nursery evaluation of <i>Tcb1+Gal-m</i> (8445-2) BC ₃ s with NC474	167
Table 183. Results of additional <i>gal</i> nursery evaluation of <i>Tcb1+Gal-m</i> (8445-5) BC ₃ s with NC474	168
Table 184. Results of <i>gal</i> nursery evaluation of <i>Tcb1+Gal-m</i> (8452-5) BC ₃ s with NC508	169
Table 185 Results of <i>Gal-s</i> nursery evaluation of <i>Tcb1+Gal-m</i> (8437-2) BC ₄ s with NC400	169
Table 186. Results of additional <i>gal</i> nursery evaluation of <i>Tcb1+Gal-m</i> (8437-3) BC ₄ s with NC400	170
Table 187. Results of <i>gal</i> nursery evaluation of <i>Tcb1+Gal-m</i> (8437-3) BC ₅ s with NC354	171
Table 188. Results of <i>Gal-s</i> nursery evaluation of <i>Tcb1+Gal-m</i> (8432-2) BC ₅ s with NC354	171
Table 189. Results of <i>Gal-s</i> nursery evaluation of <i>Tcb1+Gal-m</i> (8437-1) BC ₅ s with P4639-1	172
Table 190. Results of <i>gal</i> nursery evaluation of <i>Tcb1+Gal-m</i> (8468-2) BC ₅ s with P4639-1	173
Table 191. Results of <i>gal</i> nursery evaluation of <i>Tcb1+Gal-m</i> (8421-2) BC ₅ s with NC296	173

Table 192. Results of additional <i>gal</i> nursery evaluation of <i>Tcb1+Gal-m</i> (8421-3) BC ₅ S with NC296.....	174
Table 193. Results of <i>gal</i> nursery evaluation of <i>Tcb1+Gal-m</i> F ₂ S with NC476.....	175
Table 194. Results of additional <i>gal</i> nursery evaluation of <i>Tcb1+Gal-m</i> F ₂ S with NC476.....	175
Table 195. F ₁ topcross (to NC320xNC368) yield trial results at 5 locations over 2 years, comparisons with P31G66 and 71PM50.....	177
Table 196 Double-cross hybrid yield trail results, comparisons with P31G66 and 71PM50.....	178
Table 197. Most promising lines for <i>gal</i> resistance by accession.....	181

CHAPTER III

Table 198. Accessions used in this study and Plant Introduction numbers.....	191
Table 199. <i>Gal-m</i> resistant lines identified from evaluated accessions.....	195
Table 200. Lines containing full-strength, weakened and no resistance to <i>Gal-m</i> pollination.....	196
Table 201. Results of 1222-2 F ₂ S ₁ evaluation for <i>Gal-m</i> resistance.....	197
Table 202. Results of 1222-2 F ₂ S ₂ evaluation for <i>Gal-m</i> resistance.....	198
Table 203. Results of 1222-2 F ₂ S ₃ evaluation for <i>Gal-m</i> resistance.....	200
Table 204. Results of evaluation for <i>Gal-m</i> resistance in 1222-2 crosses from Jalisco 78.....	201
Table 205. Results of evaluation for <i>Gal-m</i> resistance in 1222-2 F ₂ S ₁ S from Jalisco 78.....	201
Table 206. Results of evaluation for <i>Gal-m</i> resistance in 1222-3 BCS ₂ S from Jalisco 78.....	202
Table 207. Results of evaluation for <i>Gal-m</i> resistance in 1222-3 backcrosses from Jalisco 78.....	203

Table 208. Results of evaluation for <i>Gal-m</i> resistance in 1223-1 F ₂ S ₁ S from Jalisco 78.....	204
Table 209. Results of evaluation for <i>Gal-m</i> resistance in 1223-1 F ₂ S ₁ S from Jalisco 78.....	205
Table 210. Results of evaluation for <i>Gal-m</i> resistance in 1223-1 F ₂ S ₃ S from Jalisco 78	206
Table 211. Results of evaluation for <i>Gal-m</i> resistance in 1223-1 BCS ₂ S from Jalisco 78.....	207
Table 212. Results of evaluation for <i>Gal-m</i> resistance in 1223-2 F ₂ S ₁ S from Jalisco 78	209
Table 213. Results of evaluation for <i>Gal-m</i> resistance in 1223-6 F ₂ S ₁ S from Jalisco 78	209
Table 214. Results of evaluation for <i>Gal-m</i> resistance in 1223-9 F ₂ S ₁ S from Jalisco 78	210
Table 215. Results of evaluation for <i>Gal-m</i> resistance in 1223-10 F ₂ S ₁ S from Jalisco 78.....	211
Table 216. Results of evaluation for <i>Gal-m</i> resistance in 1223-10 BCS ₂ S from Jalisco 78.....	212
Table 217. Results of evaluation for <i>Gal-m</i> resistance in 1226-1 F ₂ S ₁ S from Jalisco 78	212
Table 218. Results of evaluation for <i>Gal-m</i> resistance in 1226-2 F ₂ S ₁ S from Jalisco 78	213
Table 219. Results of evaluation for <i>Gal-m</i> resistance in 1226-2 F ₂ S ₂ S from Jalisco 78	214
Table 220. Results of evaluation for <i>Gal-m</i> resistance in 1226-4 F ₂ S ₁ S from Jalisco 78	214
Table 221 Results of evaluation for <i>Gal-m</i> resistance in 1226-4 F ₂ S ₂ S from Jalisco 78	215
Table 222. Results of evaluation for <i>Gal-m</i> resistance in 1226-4 BCS ₂ S from Jalisco 78....	216
Table 223. Results of evaluation for <i>Gal-m</i> resistance in 1226-4 BC ₂ S ₁ S from Jalisco 78.....	216
Table 224. Results of evaluation for <i>Gal-m</i> resistance in 1226-5 F ₂ S ₁ S from Jalisco 78.....	217
Table 225. Results of evaluation for <i>Gal-m</i> resistance in 1226-5 F ₂ S ₂ S from Jalisco 78	225
Table 226. Results of evaluation for <i>Gal-m</i> resistance in 1226-5 BCS ₂ S from Jalisco 78.....	219

Table 227. Results of evaluation for <i>Gal-m</i> resistance in 1226-5 BC ₂ S ₁ S from Jalisco 78.....	220
Table 228. Results of evaluation for <i>Gal-m</i> resistance in 1226-5 BC ₃ S from Jalisco 78.....	220
Table 229. Results of evaluation for <i>Gal-m</i> resistance in 1226-6 F ₂ S ₁ S from Jalisco 78	221
Table 230. Results of evaluation for <i>Gal-m</i> resistance in 1226-7 F ₂ S ₁ S from Jalisco 78	222
Table 231. Results of evaluation for <i>Gal-m</i> resistance in 1226-8 F ₂ S ₁ S from Jalisco 78	223
Table 232. Results of evaluation for <i>Gal-m</i> resistance in 1226-8 F ₂ S ₂ S from Jalisco 78	223
Table 233. Results of evaluation for <i>Gal-m</i> resistance in 1226-8 F ₂ S ₁ S from Jalisco 78	224
Table 234. Results of evaluation for <i>Gal-m</i> resistance in 1161-5 F ₂ S ₁ S from Jalisco 78	225
Table 235. Results of evaluation for <i>Gal-m</i> resistance in 1161-5 F ₂ S ₂ S from Jalisco 78	226
Table 236. Results of evaluation for <i>Gal-m</i> resistance in 1179-2 F ₂ S ₁ S from Jalisco 78	226
Table 237. Results of evaluation for <i>Gal-m</i> resistance in 1179-2 F ₂ S ₁ S from Jalisco 78	227
Table 238. Results of evaluation for <i>Gal-m</i> resistance in 1228-2 F ₂ S ₁ S from Jalisco 300.....	229
Table 239. Results of evaluation for <i>Gal-m</i> resistance in 1228-2 F ₂ S ₂ S from Jalisco 300.....	230
Table 240. Results of evaluation for <i>Gal-m</i> resistance in 1228-2 F ₂ crosses from Jalisco 300.....	230
Table 241. Results of evaluation for <i>Gal-m</i> resistance in 1229-5 F ₂ S ₁ S from Jalisco 300 ...	231
Table 242. Results of evaluation for <i>Gal-m</i> resistance in 1231-2 F ₂ S ₁ S from Jalisco 300 ...	232
Table 243. Results of evaluation for <i>Gal-m</i> resistance in 1231-4 F ₂ S ₁ S from Jalisco 300 ...	232
Table 244. Results of evaluation for <i>Gal-m</i> resistance in 1231-4 F ₂ S _s S from Jalisco 300.....	233
Table 245. Results of evaluation for <i>Gal-m</i> resistance in 1162-9 F ₂ S ₁ S from Jalisco 304 ...	234
Table 246. Results of evaluation for <i>Gal-m</i> resistance in 1162-9 F ₂ S ₂ S from Jalisco 304 ...	234
Table 247. Results of evaluation for <i>Gal-m</i> resistance in 1411-13 BCS ₂ S from Zacatecas 182.....	237

Table 248. Results of evaluation for <i>Gal-m</i> resistance in 1411-13 BC ₂ S ₁ s from Zacatecas 182.....	238
Table 249. Results of evaluation for <i>Gal-m</i> resistance in 3807 F ₂ S ₁ s from Zacatecas 182.....	239
Table 250. Results of evaluation for <i>Gal-m</i> resistance in crosses from Michoacán 412.....	242
Table 251. Results of evaluation for <i>Gal-m</i> resistance in crosses from Negrito-CRI2223	243
Table 252. F ₁ S ₁ families that contain resistance to pollination by both <i>gal</i> and <i>Gal-m</i>	250

APPENDIX I

Table A1-1. Results of <i>gal</i> pollination evaluation on 1179-6 derived crosses from Jalisco 78.....	254
Table A1-2. Results of <i>gal</i> evaluation on 1212-1 derived crosses from Jalisco 78.....	254
Table A1-3. Results of <i>gal</i> evaluation on 1213 derived crosses from Jalisco 78	255
Table A1-4. Results of <i>gal</i> evaluation on 1214-5 derived crosses from Jalisco 78.....	255
Table A1-5. Results of <i>gal</i> evaluation of 1226-2 and 1226-8 from Jalisco 78	255
Table A1-6. Results of <i>gal</i> isolation evaluation of 1179-6 derived lines from Jalisco 78.....	256
Table A1-7. Results of <i>gal</i> isolation evaluation of 1212-1 derived lines from Jalisco 78.....	256
Table A1-8. Results of <i>gal</i> nursery evaluation of NC296x1223-1 F _{3:1} crosses from Jalisco 78.....	256
Table A1-9. Results of <i>gal</i> nursery evaluation of 1163-2 F ₁ crosses from Jalisco 304.....	257
Table A1-10. Results of <i>gal</i> nursery evaluation of a 1170 F ₁ line from Jalisco 304	257
Table A1-11. Results of <i>gal</i> nursery evaluation of 1238-12 BC ₁ line from Jalisco 304	257
Table A1-12. Results of <i>gal</i> nursery evaluation of 1238-12 BC ₁ line from Jalisco 304	257

Table A1-13. Results of <i>gal</i> nursery evaluation of 9537-1(264-1) F _{2:1} crosses from Zacatecas 40.....	258
Table A1-14. Results of <i>gal</i> nursery evaluation of 9538-9(8601-3) BC ₂ crosses from Zacatecas 40.....	258
Table A1-15. Results of <i>gal</i> nursery evaluation of 1349-2 BC ₁ crosses from Zacatecas 182.....	258
Table A1-16. Results of <i>gal</i> nursery evaluation of 1349-3 BC ₁ crosses from Zacatecas 182.....	258
Table A1-17. Results of <i>gal</i> nursery evaluation of 1349-4 BC ₁ crosses from Zacatecas 182.....	259
Table A1-18. Results of <i>gal</i> nursery evaluation of 1411-4 BC ₁ crosses in two backgrounds from Zacatecas 182.....	259
Table A1-19. Results of <i>gal</i> nursery evaluation of 1411-5 BC ₁ crosses from Zacatecas 182.....	259
Table A1-20. Results of <i>gal</i> nursery evaluation of 1411-6 pseudo-BC ₁ crosses from Zacatecas 182.....	260
Table A1-21. Results of <i>gal</i> nursery evaluation of 9539-3 pseudo-BC ₁ crosses from Zacatecas 182.....	260
Table A1-22. Results of <i>gal</i> nursery evaluation of 9539-2 BC ₁ crosses from Zacatecas 182.....	260
Table A1-23. Results of <i>gal</i> nursery evaluation of 9521-5 F ₁ crosses from Benz 875.....	261
Table A1-24. Results of <i>gal</i> nursery evaluation of LH51x9522-3 F ₁ crosses from Benz 875.....	261
Table A1-25. Results of evaluation for <i>Gal-m</i> resistance in NC368x3801 F ₂ crosses from Jalisco 78.....	261
Table A1-26. Results of evaluation for <i>Gal-m</i> resistance in NC320x3801 F ₂ crosses from Jalisco 78.....	262
Table A1-27. Results of evaluation for <i>Gal-m</i> resistance in 9525 and 9526 BC ₁ crosses from Jalisco 78.....	262
Table A1-28. Results of evaluation for <i>Gal-m</i> resistance in 9525 F ₁ crosses from	

Jalisco 78.....	263
Table A1-29. Results of evaluation for <i>Gal-m</i> resistance in various crosses from Jalisco 78.....	263
Table A1-30. Results of evaluation for <i>Gal-m</i> resistance in 1162-9 lines from Jalisco 304.....	263
Table A1-31. Results of evaluation for <i>Gal-m</i> resistance in 1162-9 F ₂ S ₁ S from Jalisco 304.....	263
Table A1-32. Results of evaluation for <i>Gal-m</i> resistance in 1170-8 F ₂ S ₁ S from Jalisco 304.....	264
Table A1-33. Results of evaluation for <i>Gal-m</i> resistance in 1172-3 F ₂ S ₁ S from Jalisco 304.....	264
Table A1-34. Results of evaluation for <i>Gal-m</i> resistance in 1173-4 F ₂ S ₁ S from Jalisco 304.....	265
Table A1-35. Results of evaluation for <i>Gal-m</i> resistance in 1349-5 and 1411 crosses from Zacatecas 182.....	265
Table A1-36. Results of evaluation for <i>Gal-m</i> resistance in 3807 crosses from Zacatecas 182.....	266
Table A1-37. Results of evaluation for <i>Gal-m</i> resistance in 9539 and 9540 crosses and lines from Zacatecas 182	266
Table A1-38. Results of evaluation for <i>Gal-m</i> resistance in crosses and lines from Zacatecas 40.....	267
Table A1-39. Results of evaluation for <i>Gal-m</i> resistance in crosses and lines from Guanajuato 100	268
Table A1-40. Results of evaluation for <i>Gal-m</i> resistance in crosses and lines from Guanajuato 141	269
Table A1-41. Results of evaluation for <i>Gal-m</i> resistance in crosses and lines from Guanajuato 181	270
 APPENDIX II	
Table A2-1. Description of non-experimental material used.....	271

Table A2-2. Yield trial site details for 2013-2014 yield trials	272
Table A2-3. Additional topcross yield trial results from a trial at 5 Locations in 2014	272
Table A2-4. Single-plant selections where <i>Gal-m</i> resistant lines were identified	273

APPENDIX III

Table A3-1. Analysis of Variance for Yield of F ₁ Topcross Yield Trial Over Years and Locations using A.FOR.....	276
Table A3-2. Analysis of Variance for Percent Moisture of F ₁ Topcross Yield Trial Over Years and Locations using A.FOR.	276
Table A3-3. Analysis of Variance for Percent Erect Plants of F ₁ Topcross Yield Trial Over Years and Locations using A.FOR.	277
Table A3-4. Analysis of Variance for Yield of F ₂ Topcross Yield Trial Over Years and Locations using A.FOR.....	277
Table A3-5. Analysis of Variance for % Moisture of F ₂ Topcross Yield Trial Over Years and Locations using A.FOR.	278
Table A3-6. Analysis of Variance for % Erect Plants of F ₂ Topcross Yield Trial Over Years and Locations using A.FOR.	278

LIST OF FIGURES

Chapter II

Figure 1. Production method comparison for DGF-containing hybrids	19
---	----

Chapter I: Literature Review

Some maize (*Zea mays* L.) genotypes are known to carry genes that confer selective pollination through a pollen-pistil allele matching system. These genes, called gametophyte factors, often result in increased proportion of self-fertilization and produce non-Mendelian segregation ratios (Kermicle and Evans, 2005). This phenomenon has been known in maize since the 1920's when Demerec reported unsuccessful crosses when using a popcorn line as a female parent in crosses with sweet corns, while the reciprocal pollination worked successfully (Demerec 1929, Nelson 1951). The first reported factor of this type, *Gametophyte factor 1 (Gal)*, was identified through crosses between sweetcorn (*gal gal sul sul*) containing the linked *sugary1* locus, and popcorn (*Gal Gal Sul Sul*) which resulted in a significant deficiency of sugary type kernels in the F₂ (Mangelsdorf and Jones, 1926). Through distorted segregation ratios in the F₂ and F₃, it was shown that a dominant factor (*Gal*) linked to *sugary1* adequately explained the experimental results.

In plants homozygous (*Gal /Gal*) or heterozygous (*Gal /gal*) for the *Gal* allele, *Gal* pollen is preferred over *gal* pollen, with the recessive pollen achieving fertilization in only 0-4% of the ovules in presence of competition from *Gal* (Schwartz, 1950). In the (*gal /gal*) case, pollen carrying either allele variant is equally competitive in fertilization. In the absence of competition between pollen types, recessive pollen will fertilize both ovule types. A third variant at this locus, *Gal-s*, has a stronger effect, and conditions nonreciprocal cross-sterility. In this case, fertilization by *gal* pollen completely fails on silks that are homozygous for *Gal-s*, even in the absence of competing pollen, while ears heterozygous for *Gal-s* usually produce partial seed set (Schwartz, 1950). *Gal-s* pollen will, however, induce

full fertilization on *gal/gal* plants. An additional allele of *gal*, designated *Gal-m*, has male-only action and is cross neutral. Plants containing *Gal-m* can fertilize all genotypes, including *Gal-s* homozygotes, and accept pollen from all other pollen classes (*gal*, *Gal-s*, *Gal-m*; Kermicle, Taba and Evans, 2006). A study of environmental and genotype x environment effects on the effectiveness of the *gal* cross sterility system revealed that both of these effects were non-significant, indicating that the trait is entirely genetically controlled (Gonzalez, 2011). Broad-sense heritability of cross incompatibility was estimated in this experiment on an entry mean basis, and was reported to be 0.81, suggesting selection for cross incompatibility should be effective across a wide variety of environments.

The *Gal-s* allele imparts selective fertilization through differential pollen tube growth towards the ovary. This was demonstrated in a study in which both *gal* and *Gal-s* pollen were labeled with ³²P prior to shed, and used to pollinate *Gal-s* homozygotes (Nelson, 1994). Autoradiographs of silks removed at various intervals revealed that *gal* pollen germinated and the pollen tubes grew into the stylar canals, although it was notably slower to do so than *Gal-s* pollen, and eventually ceased growth altogether, short of the ovule. This pre-zygotic system is an important distinction from a post-zygotic lethality system. Kermicle and Evans (2005) showed that the alleles are controlled by allele-specific congruence rather than active rejection, meaning that the genotype of the pollen matches the genotype of the pistil, allowing for a successful interaction, or possibly that a mismatch triggers an incompatible reaction.

Ga-1 was originally mapped to chromosome 4 via classical linkage studies, and was found to be 23.2 map units from *Su1* (Mangelsdorf and Jones, 1926). Through the use of a homogeneous mapping population, *Ga1* was localized to a 100 Kb region on chromosome 4, between dCS1 and ID7 markers on the B73 reference genome (Liu et al, 2014). The study reported 3 predicted genes, one of which has homology to WDL1 from *Arabidopsis* and could have some impact on pollen tube growth. This information aligns with the previous observations about the mechanism of isolation. A study to evaluate the effectiveness of using simple-sequence repeat (SSR) markers to predict the allelic state of the *gal* locus suggested that the process was inefficient when compared to phenotyping (Gonzalez, 2011). That study used 28 SSRs in close proximity to *gal*, and found markers only capable of correctly predicting allelic state of up to 70% of the progeny, making it too inefficient to effectively identify lines for the production of *Ga1-s* inbred lines.

The distribution of alleles at the *gal* locus is nonrandom across types of maize (Nelson, 1993). The *Ga1-s* allele is abundant in popcorns, with the majority containing the allele, although there are several exceptions (Nelson, 1952). An extensive test of Central and South American landraces by Nelson showed that the many races were homozygous for *Ga1-s* or for *Ga1* (Nelson, 1960). It was especially noted that all of the more complex Mexican races tested were homozygous for one of these two factors. However, close examination of the information presented by Nelson shows there is a disparity between his nomenclature and the current nomenclature used to describe the *Ga1/ga1* system. Nelson's conclusions were based on experimental lines pollinating/not pollinating a *Ga1-s/Ga1-s* tester stock as male, and receiving/not receiving *gal* pollen as female. From observations, he described three

classes of action. The first, which is designated Ga^s , is characterized by blocking *gal* pollen as female, and successfully pollinating a *Gal-s* tester stock. The second class, designated Ga , is characterized by accepting *gal* pollen as female, and successfully pollinating a *Gal-s* tester stock. The third class, designated ga , is characterized by accepting *gal* pollen as female, and failing to pollinate a *Gal-s* tester stock. When we consider these three types of action in modern nomenclature, the first and third classes remain correctly identified, but the second class, “ Ga ”, matches the modern description of *Gal-m* alleles. Re-examination of Nelson’s results in this light changes the conclusions of his study. Varieties Zapalote Grande, and Guatemala 229H, among others, were designated “ Ga ” by Nelson, but can be reasonably considered to be *Gal-m*-containing in current nomenclature. Races, like Palmero Toluqueño, that were designated as “ ga ” as well as those like Maiz Dulce, classified as “ Ga^s ”, are correctly classified. However, Nelson designated eleven races as “ Ga^s or Ga ”, meaning they either contained *Gal-s* or *Gal-m*. These eleven races can be said to be able to pollinate *Gal-s* testers, but their genetic constitution is inconclusive without information about their ability to block *gal* pollen. In light of the presence of *Gal-m* and a dominant-acting *Gal-s*, which we putatively report, the conclusion that all of the more complex Mexican materials tested were homozygous seems unlikely. It seems probable that many of the races classified as “ Ga^s or Ga ” are actually *Gal-m* containing races, and as such successfully pollinated the tester. Due to this confusion, nomenclature for this system is occasionally confusing. In this study, Nelson also identified Palmero Toluqueño and Harinoso de Ocho as homozygous for *gal*. These races, an indigenous popcorn and a putative Pre-Columbian Exotic, respectively, show the existence of primitive races that are *gal* homozygotes. This fact is especially important

when considering that all United States varieties that have been tested, with the exception of popcorns and Papago Indian Corn, have all been found to be *gal* homozygotes. It is also important to note that Palmero Toluqueño, in light of these results, is not a likely source of the *Gal-s* popcorns, as some in the popcorn breeding community have speculated. A screen for the presence of *gal* alleles in 84 commercial hybrids planted in Mexican tropical, subtropical and highland areas revealed that the majority (55%) of these were homozygous for *Gal-m*, further supporting our conclusions about Nelson's study (de la Cruz et al., 2008). Of the remaining hybrids in the study, 20% were *Gal-m* heterozygotes, 25% were homozygous for *gal*, and *Gal-s* was not found in any of the hybrids screened. This difference of US races from other American races is interesting due to the nature of the *gal* system, in which *Gal-s* alleles have nearly complete competitive advantage over *gal*, meaning that, if introduced into a population, *Gal* alleles should quickly go to fixation (Nelson, 1952). The almost perfect uniformity of *gal* in US races means that they must have developed from an ancient *gal* homozygote, which studies show existed, and also raises important, and yet unanswered, questions about the evolution of the species.

The *gal* alleles have been proposed to have played an important biological role in the development of *Zea mays* subspecies through preventing hybridization between maize and weedy teosintes growing nearby (Kermicle, Taba and Evans, 2006). When teosintes were screened, five of six accessions of *Zea mays* ssp. *mexicana* and one accession of *Zea mays* ssp. *huehuetenangensis* were found to contain *Gal-s* alleles, and were thus unable to set seed when pollinated with dent corn (*gal*) pollen (Nelson, 1993). Subsequent screening of 14 teosinte accessions revealed that *gal* alleles are equally distributed across the collections, but

are decidedly nonrandom with respect to natural habitat of the accession (Kermicle, Taba and Evans, 2006). Wild species were found to contain alleles lacking the pistil barrier (*gal*, *Gal-m*), while weedy species were found to contain *Gal-s*, consistent with it being an isolation factor from sympatric maize. However, while examining the naturally occurring sympatric maize races corresponding to each teosinte accession, it was discovered that many (11 of 13) Mexican highland maize races only contain *Gal-m*, which readily fertilizes *Gal-s* homozygous plants. An examination of *Gal-m* competition on homozygous *Gal-s* silks revealed that there was a significant decrease in number of seed set due to *Gal-m* pollen in homozygous *Gal-s* plants when a mixture of *Gal-s* and *Gal-m* pollen was applied to the silks, when compared to seed set on *gal* homozygotes, indicating that *Gal-m* is not fully competitive on *Gal-s* silks.

In a subsequent study of cross-incompatibility between maize and teosinte, Kermicle and Allen (1990) identified a parallel system of cross-sterility in teosinte accession “Central Plateau 48703”, which involves a chromosome 4 complex, designated TIC-CP for Teosinte Incompatibility Complex-Central Plateau, which prevents pollination by *Gal-s* or *gal* when plants are heterozygous for the complex. One component of the TIC complex is the pollen-specific allele of *gal*, *Gal-m*, which readily pollinates both *gal* and *Gal-s* ears. Another component of the complex occurred among sublines in which *Gal-m* had been replaced by *gal* from maize. This variant line, CP2, pollinated a TIC tester but was also receptive to *gal* and *Gal-s* pollen. This means that CP2 lines have analogous behavior in the TIC system as *Gal-m* does to the *gal* system (Nelson 1993). A prominent locus conferring cross-sterility has been mapped within the TIC complex. The locus, designated *tcb1* for teosinte crossing

barrier, is a parallel system to that of *gal*. The nomenclature from the *gal* system has been adapted to the *tcb1* system, with plants carrying both male and female functions being designated *Tcb1-s*. Similarly, plants carrying male only function are designated *Tcb1-m*, and analogously successfully pollinate *Tcb1-s* ovules, while accepting *tcb1* pollen (Lu, Kermicle and Evans, 2014).

The introgression of *Tcb1-s* (with *Gal-m* present) into maize was performed by crossing teosinte accession Central Plateau 48703 to various *gal tcb1* maize stocks, then crossing successively to W22 (NSL 30053), an American Midwest inbred lacking any known incompatibility factors, for five generations before selfing to establish homozygous lines (Evans and Kermicle, 2001). *Tcb1*, although it is a complex locus containing several factors, is generally inherited as one unit (Lu, Kermicle Evans, 2014). Through the use of a chromosome four tester stock, with visible markers *v17 bm3* and *su1*, crossed with a *Ts5* strain of *Tcb1*, a 5-point testcross population was generated allowing for mapping of *tcb1*. The *tcb1* locus was mapped to a region on the short arm of chromosome 4, 44cM from *Gal* and 6cM from *sugary1*. *Tcb1-s* homozygotes also often suffer from poor seed set, likely due to the increased pollen tube length in maize, resulting in yield drag in homozygotes (Sanchez et al., 2011).

Through repeated backcrossing to maize stocks, attenuated versions of *Tcb1* have been identified, suggesting the presence of positive modifiers of the locus, which may have been lost through recombination (Evans and Kermicle, 2001). The weakened versions, coming with the replacement of *Gal-m* from teosinte by *gal* from maize, were notably more

receptive to *Gal-s* pollen than to *gal* pollen, while full-strength versions were completely non-receptive to both pollen types, indicating that *Gal-m* was a possible candidate for a stabilizing modifier. Replacement of *Gal-m* in attenuated versions did not restore the lines to full strength, suggesting that the modifier gene/genes for *Tcb1* are located nearby, and the loss of *Gal-m* was coincident with modifier loss. In subsequent publications the authors suggest the action may be epigenetic, rather than due to a modifier/modifiers, but note that the presence of such modifiers cannot be ruled out at present (Lu, Kermicle and Evans, 2014).

The attenuated lines were shown to progressively weaken in pistil function of *Tcb1* until the barrier was lost across 10 generations of backcrossing to W22 (Lu, Kermicle and Evans, 2014). The weakening of these lines only impacted the pistil barrier, with the male function retaining full strength. Examination of this aspect found that the *Tcb1* locus has individual male and female components, designated *Tcb1-m* and *Tcb1-f*, which were separated by rare recombination events. *Tcb1-m* is distal to *Tcb1-f* on the short arm of chromosome 4 (Lu, Kermicle and Evans, 2014). *Tcb1-m* plants can successfully pollinate *Tcb1-s* silks, but behave as *tcb1* in the female, while *Tcb1-f* is incapable of pollinating *Tcb1-s* silks, but blocks *tcb1* pollen in the female.

Tcb1's potential role in filling the cross incompatibility gap left by the status of the *gal* system between teosinte and sympatric maize needed for reproductive isolation depends on the allelic states of *tcb1* in these populations. Kermicle (2006) examined the allelic constitution at the *tcb1* locus of thirteen teosintes paired with their sympatric maize races and

found that eight of the teosintes contained *Tcb1-s*, four were homozygous *tcb1*, and one contained *Tcb1-m*. When these collections were pollinated with a *Gal-m tcb1* maize inbred, used to match the allelic composition of maize populations indigenous to the teosinte collection region, the eight *Tcb1-s* containing populations produced significantly fewer seeds than if pollinated by teosinte. Three plants of each sympatric maize population were also examined, and were found to be uniformly *tcb1* homozygotes. The author notes that all Midwestern US lines that have been evaluated to date are also uniformly *tcb1* homozygotes, although data was not provided.

The mechanism of pollen isolation for *Tcb1*, like that of *gal*, is pre-zygotic pollen tube growth arrest. The pre-zygotic nature of the system was confirmed by pollinating with incompatible pollen, then compatible pollen, on successive days, resulting in full seed, indicating that the ovule viability was maintained despite the incompatible pollen interaction (Evans and Kermicle, 2001). The successful fertilization by incompatible pollen at the tip of the cob in weakened versions of *Tcb1* aligns with this finding, suggesting that restriction of pollen tube growth is responsible for blocking fertilization, but that the shorter silks do not provide ample space to effect the restriction in these attenuated systems (Lu, Kermicle and Evans, 2014). This was confirmed by examining the growth of pollen tubes in compatible and incompatible pollen interactions 24 hours after pollination. When *tcb1* pollen was placed on homozygous *tcb1* silks, pollen tubes traveled 97% of the silk distance, on average. When *tcb1* pollen was placed on homozygous *Tcb1* silks, pollen tubes could only be found at the tip of the silks, having traveled only 28% of the silk distance, on average. Interestingly, when *tcb1* pollen was placed on homozygous *Gal-s* silks, the distance traveled was only 12%,

shorter than that of the *Tcb1-tcb1* incompatibility interaction. When the length of the pollen tube within the silks was examined, *Tcb1* silks had much longer growth than that of *Gal-s* silks (5.8 cm vs. 2.4 cm at 24 hours after pollination), indicating that *Gal-s* has a stronger response to *tcb1* pollen than does *Tcb1*. Examination of pollen tube growth within the stylar canal revealed that the two incompatibility systems had different action within the pollen tube. When pollinated with incompatible pollen, *Tcb1* showed thicker callous deposition, indicating a thicker callous layer on the cell wall, but otherwise normal growth. *Gal-s* pollen tube growth showed evidence of misdirection, as well as thick, uneven callous deposits. The different signatures of these two systems within the stylar canal during pollen rejection may indicate different mechanisms for pollen tube restriction between the systems.

When tested, *Gal-s* homozygotes are unreceptive to both *Tcb1* and *tcb1* pollen, but heterozygotes (*Gal-s/gal*) are notably more receptive to *Tcb1* pollen than *tcb1*. Full strength *Tcb1*, when combined with positive modifiers, is non-receptive to both *Gal-s* and *gal* pollen. When the modifiers are absent, the attenuated version is detectably more receptive to *Gal-s* than to *gal* pollen. That the two systems both show preference to the active isolation factor (*Tcb1* on *Gal-s/-* silks and vice versa) of the other system over the inactive isolation factor (*tcb1*, *gal*) indicating that there is partial recognition between the two systems of incompatibility (Evans and Kermicle, 2001).

The use of cross-sterility systems has long been advocated for various uses, ranging from contamination prevention in special endosperm types to protection of sweet corns (Nelson, 1952). The *gal* system has also been widely used to prevent contamination of

popcorn fields with dent pollen (called dent sterile in this system), due to the abundant nature of the *Gal-s* allele in popcorns and the need for ensured product quality without extensive isolation from dent corn. In recent years, utilization of cross-sterility systems has shifted to potential uses for protecting conventional and organic varieties from contamination with Genetically Modified (GM) pollen. The rapid growth in the percentage of land planted to GM varieties, an increase of 68% from 2000 to 2014, has made production of non-GM corn increasingly difficult due to regulations on GM contamination (NASS, 2014, Weber et. al, 2007). As a wind-pollinated species, maize is prone to cross-fertilization with plants in nearby fields, causing some European Union countries to create isolation distances between GM and non-GM crops ranging from 15 to 800m; distances are often greater for organic crops (Devos et al, 2009). A similar situation occurs with certified organic production systems in the United States. Since “organic” is a legally defined term, producers are required to follow regulations for preventing contamination in their crop which, in the case of preventing GM cross-fertilization, can involve being required to plant extensive buffers, a situation that is impracticable at best, and which adds up to lost profit for producers (OFARM, 2014). A producer has the potential to lose the ability to sell grain as organic if GM contamination is present, which can result in significant profit loss due to the price of organic corn relative to conventional corn (<http://ams.usda.gov/mnreports/lbnoof.pdf>). In a survey of organic producers, the median loss of rejected grain due to GM contamination was \$4500 (OFARM, 2014). The same survey showed 59% of surveyed organic farmers identified themselves as very concerned about GM contamination in their operations, and 68% of respondents believed that good stewardship alone was “inadequate” or “very

inadequate” to prevent organic/non-GMO farmers from unintended contamination. The use of cross-incompatibility genes has ready and obvious applications in protecting profits for these growers, as well as insuring quality standards for consumers concerned about the safety of GM grain. As shown, there is economically-driven producer interest in preventing cross-fertilization in maize, a role that gametophyte factors can readily fill.

Our intention with this study was to find dominant pollen blockage, either through *Gal-s* alleles with dominant action or through some alternative that did not suffer from the yield drag associated with *Tcb-1*. As this research began, the prevalence of *Gal-m* in Mexican corn varieties was reported by de la Cruz et. al. (2008), leading to a second goal of identifying *Gal-m* resistant germplasm sources due to the eventual need for lines to have both dominant pollen blockage and resistance to *Gal-m* for successful producer use. The starting point for locating such germplasm was also based on Sanchez et. al. (2011) who suggested some accessions that might contain this unique set of traits. Fortunately, the corn program at North Carolina State University has an extensive germplasm collection from which we could obtain seed to evaluate these accessions. Without this collection, evaluation of several accessions would not be possible, highlighting the need for improved care for our plant germplasm resources.

Literature Cited

- de la Cruz, L., J. Sanchez, J. Ron, B. Baltazar, J.A. Ruiz, & M.M. Morales. (2008). El factor gametofítico-1 (*gal*) en híbridos comerciales de maíz de México. *Revista Fitotecnia Mexicana*, 31(1), 57-65.
- Demerec, M. (1929). Cross-sterility in maize. *Indukt Abstamm Vererbungsl*, 50, 281-291.
- Devos, Y., Demont, M., Dillen, K., Reheul, D., Kaiser, M., & Sanvido, O. (2009). Coexistence of genetically modified (GM) and non-GM crops in the European Union. A review. *Agronomy for Sustainable Development*, , 11-30.
- Gonzalez, M. D. (2011). Screening and genotyping of *gal* gene and genotype x environment interaction of cross incompatibility in maize. (Doctor of Philosophy, Iowa State University). *Graduate Theses and Dissertations*,
- Kermicle, J. L. (2006). A selfish gene governing pollen-pistil compatibility confers reproductive isolation between maize relatives. *Genetics*, 172, 499-506.
- Kermicle, J. L., Taba, S., & Evans, M. M. S. (2006). The gametophyte-1 locus and reproductive isolation among *Zea mays* subspecies. *Maydica*, 51, 219-225.
- Kermicle, J., & Evans, M. (2005). Pollen-pistil barriers to crossing in maize and teosinte result from incongruity rather than active rejection. *Sexual Plant Reproduction*, 18, 187-194.
- Liu, X., Sun, H., Wu, P., Tian, Y., Cui, D., Xu, C., et al. (2014). Fine mapping of the maize cross-incompatibility locus *Gametophytic Factor 1 (gal)* using a homogeneous population. *Crop Science*, 54, 873-881.
- Lu, Y., Kermicle, J., & Evans, M. (2014). Genetic and cellular analysis of cross-incompatibility in *Zea mays*. *Plant Reproduction*, 27, 19-29.
- Mangelsdorf PC, Jones D. (1926). The expression of Mendelian factors in the gametophyte of maize. *Genetics*, 11, 423-455.
- Nelson, O. (1952). Non-reciprocal cross-sterility in maize. *Genetics*, 37, 101-124.
- Nelson, O. (1960). The fourth chromosome factor in some Central and South American races. *Maize Genetics Cooperation News Letter*, 34, 114-116.
- Nelson, O. (1993). The gametophyte factors of maize. *The Maize Handbook* (pp. 496-503). New York: Springer-Verlag.

Organic Farmers' Agency for Relationship Marketing (OFARM), Food and Water Watch. (2014). "*Organic farmers pay the price for contamination*" issue brief. Retrieved 07/28, 2014, from http://documents.foodandwaterwatch.org/doc/GMO_contamination.pdf

Sanchez, J., Padilla, J., de la Cruz, L., Ron, J., Holland, J., Krakowsky, M., et al. (2011). Use of gametophytic isolating mechanisms for maize. *Plant Breeding News*, 230, 1.14.

Schwartz D. (1950). The analysis of a case of cross-sterility in maize. *Proceedings of the National Academy of Science*, 36, 719-724.

Weber, W., & T. Bringezu, I. Broer, J. Eder, and F. Holz. (2007). Coexistence between GM and non-GM maize crops – tested in 2004 at the field scale level. *Journal of Agronomy and Crop Science*, 193, 79-92.

Chapter II: Evaluation of Tropical Maize Germplasm for Dominant Gametophyte Factors

Some maize (*Zea mays* L.) genotypes are known to carry genes that confer selective pollination through a pollen-pistil allele matching system. These genes, called gametophyte factors, often result in increased proportion of self-fertilization (Kermicle and Evans, 2005). This phenomenon has been known in maize since the 1920's when Demerec reported unsuccessful crosses when using a popcorn line as a female parent in crosses with sweet corns, while the reciprocal pollination worked successfully (Demerec 1929, Nelson 1952). Gametophyte factors in maize, although complex, are generally inherited as a whole, giving them simple Mendelian inheritance patterns. Two of these allele systems, *gametophyte factor 1* (*gal*) and *teosinte crossing barrier 1* (*tcb1*), are especially interesting due to allele variants that condition non-reciprocal cross-sterility (Nelson, 1994; Lu, Kermicle and Evans, 2014). In plants homozygous (*Gal /Gal*) or heterozygous (*Gal /gal*) for the *Gal* allele, *Gal* pollen is preferred over *gal* pollen, with the recessive pollen achieving fertilization in only 0-4% of the ovules in the presence of competition (Schwartz, 1950). In the homozygous recessive (*gal /gal*) case, pollen carrying either allele variant is equally competitive in fertilization. In the absence of competition between pollen types, recessive pollen will fertilize all ovule types. A third variant at this locus, *Gal-s*, has a stronger effect, and conditions nonreciprocal cross-sterility. In this case, fertilization by *gal* pollen completely fails on silks that are homozygous for *Gal-s*, even in the absence of competing pollen, while ears heterozygous for *Gal-s* produce partial seed set (Schwartz, 1950). *Gal-s* pollen will, however, induce full fertilization on *gal /gal* plants. *Tcb1* is a parallel system to *gal*, and nomenclature has been

adopted to reflect this parallel, so that *Tcb1-s* has the same function in the *tcb1* system that *Gal-s* has in the *gal* system (Lu, Kermicle and Evans, 2014).

There is also a male-only allele of *gal*, designated *Gal-m*, which has promiscuous action in the incompatibility system. Plants containing *Gal-m* can fertilize all genotypes at that locus, including *Gal-s* homozygotes, and accept pollen from all other pollen classes (*gal*, *Gal-s*, *Gal-m*; Kermicle, Taba and Evans, 2006). This allele is widespread in commercial hybrids grown in Mexico, is present in several NC inbred lines, and has been reported in at least one U.S. commercial hybrid (de la Cruz, 2008; Hoegemeyer, personal communication; Sanchez et al., 2011, <http://www.cropsci.ncsu.edu/maize/germplasm.html>). The abundance of this allele, and its likely increase through efforts to broaden the genetic base of maize, presents a problem for the use of the *gal* system to effectively isolate pollen since any non-target pollen carrying even one copy of *Gal-m* would pollinate a *Gal-s* hybrid, rendering the isolation mechanism useless. Fortunately, these alleles remain rare in U.S. commercial hybrids, so they are not of immediate concern, but should be considered for longer-term breeding work.

The use of cross-sterility systems has long been advocated for various uses, ranging from contamination prevention in special endosperm types to protection of sweet corns (Nelson, 1952). The *gal* system has also been widely used to prevent contamination of popcorn fields with dent pollen (called dent sterile in this system), due to the abundant nature of the *Gal-s* allele in popcorns and the need for ensured product quality without extensive isolation from dent corn. In recent years, utilization of cross-sterility systems has shifted to

potential uses for protecting conventional and organic varieties from contamination with genetically modified (GM) pollen from commercial dent corn hybrids. The rapid growth in the percentage of land planted to GM varieties, an increase of 68% from 2000 to 2014, has made production of non-GM corn increasingly difficult due to regulations on GM contamination (NASS, 2014, Weber et. al, 2007). As a wind-pollinated species, maize is prone to cross-fertilization with plants in nearby fields, causing some European Union countries to create isolation distances between GM and non-GM crops ranging from 15 to 800m (Devos et al, 2009). One study has suggested that distances of at least 750 m and plating separation of at least two weeks is needed to achieve 0% GM contamination in corn (Halsey et al, 2005). A similar situation occurs in certified organic production systems in the United States. Since “organic” is a legally defined term, producers are required to follow regulations for preventing contamination in their crop which, in the case of preventing GM cross-fertilization, can involve the requirement to plant extensive buffers, a situation that is impracticable at best, and which adds up to lost profit for producers (OFARM, 2014). The use of cross-incompatibility genes has ready and obvious applications in protecting profits for these growers, as well as insuring quality standards for consumers concerned about the safety of GM grain. However, the nature of the *Gal-s* and *Tcb-1* systems require the production of homozygous lines containing a factor, requiring extensive breeding work, and even more complicated maintenance of inbred lines for commercial hybrids.

A more effective barrier to pollen contamination would be a dominant gametophytic factor (DGF) which allows for use in a heterozygous state. *Tcb1-s* is a DGF isolated from teosinte but, when it is introgressed into maize, homozygous lines produce poor seed set

(Sanchez et al., 2011). This problem, most likely due to the increased pollen tube length in maize, results in poor yield making the system less desirable. While this is not problematic for producer use since producers will use heterozygous hybrids, it complicates the use and maintenance of parental lines for hybrid seed production, a challenge that would likely prevent the commercialization of such lines. The production of hybrid seed of this type involves crossing two parental inbreds (AxB). If B is homozygous (DGF/DGF) for the DGF, and is used as the male pollen source, then hybrid AB would block *gal* pollen (DGF/_), and inbred A would not need to carry the DGF. Alternatively, the use of two inbred lines (C and D), both heterozygous (DGF/dgf) for the DGF, would produce hybrid seed either homozygous (DGF/DGF) or heterozygous (DGF/dgf), since the third class (dgf/dgf) would fail to pollinate the parent ear and would not produce seed (dgf/dgf is recessive lethal on DGF/_). Figure 1 shows these two seed production methods. The latter system has a distinct advantage of being less time consuming in that there is no need to identify homozygous parents, but faces a substantial limitation when considering the yield drag associated with homozygous *Tcb1-s* plants. Hybrid CD would produce uniformly isolating lines, but would segregate for yield if *Tcb1-s* is used, due to (*Tcb1-s/Tcb1-s*) plants producing poor seed sets, a problem faced with *Tcb1* homozygotes in maize. This segregation of yield would be quite problematic from a seed production standpoint, further limiting any chance such lines have at commercialization if *Tcb1-s* is used as the DGF.

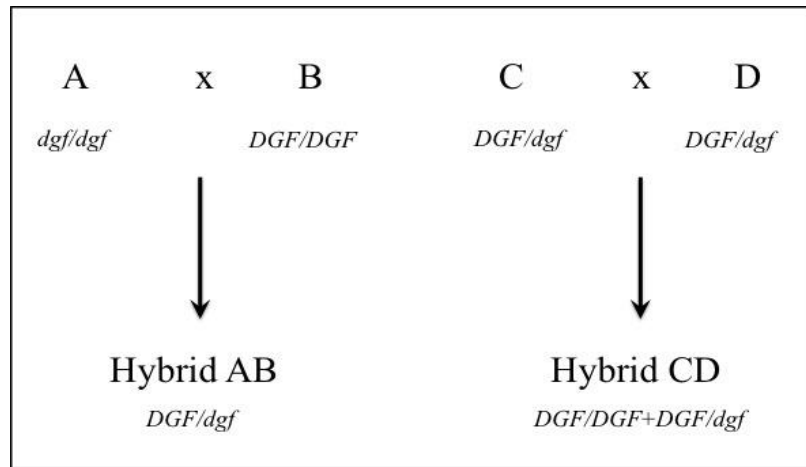


Figure 1. Production method comparison for DGF-containing hybrids

One possible solution to this problem is to identify DGFs from maize accessions that may not be associated with any yield drag. José de Jesús Sánchez González, at the University of Guadalajara, hypothesized that unstudied isolation mechanisms might be identified in specialty corn accessions (Sanchez et al., 2011). DGFs identified from these accessions would likely not have the yield problems associated with DGFs derived from teosinte since farmers would have minimized these negative effects over years of cultivation. Use of DGF-containing inbred lines derived from these accessions would allow hybrid seed production by crossing CxD as described above, saving time in line evaluation and overcoming the yield problems associated with homozygous *Tcb1-s* lines. A second option is to identify *Tcb1* lines that overcome the associated yield drag through backcrossing into adapted material. This study reports the examination of various accessions of specialty corns for the presence of DGFs and a screen for *Tcb1* lines that do not segregate for yield.

Materials and Methods

Plant Material

This study consists of examination landraces and cultivated materials from the race Maiz Dulce. Accessions evaluated are listed in Table 1.

Table 1. Accessions evaluated with Plant Introduction numbers

Accession	PI Number
Benz 875	Ames 19955
Benz 878	Ames 19957
Guanajuato 100	PI 629166
Guanajuato 141	PI645801
Guanajuato 181	PI 628428
Jalisco 300	PI 484570
Jalisco 304	PI 484574
Jalisco 78	PI 483568
Michoacán 412	PI 629228
Palomero tipo de Chihuahua	PI 484422
Z07-011	PI 503576
Zacatecas 182	PI 646105
Zacatecas 40	PI 629262

These were crossed with standard North Carolina lines and hybrids, as well as Ex-PVP lines, which are summarized in Appendix II Table 1. Further description of NC materials is available from the NCSU Maize Breeding website (<http://www.cropsci.ncsu.edu/maize>).

A homozygous *Tcb1+Gal-m/Tcb1+Gal-m* line in a W22 background obtained from Jerry Kermicle (University of Wisconsin) was backcrossed into standard North Carolina lines mentioned below. The source of *Gal-m* was White Rice popcorn inbred 4519, and the *Tcb1-s* source is from teosinte, both of which were backcrossed into W22 (Kermicle and Evans, 2005). *Tcb1* was crossed/backcrossed into NC inbred lines NC296, NC354, NC368, NC400, NC474, NC476, NC508, and ex-PVP inbred HBA1 for up to five backcrosses, and were evaluated for maintained resistance to *gal tcb1* or *Gals tcb1* pollen by pollinating the top ear of the father plant with such pollen.

Field Design, Material Development and Evaluation

In winter 2011, accessions were crossed to adapted material by a commercial cooperator, seed of which was planted ear to row in summer 2012 on April 9 at Central Crops Research Station in Clayton, NC. Delay rows were planted at seven day intervals in an attempt to align flowering between experimental lines and desired inbreds. Experimental rows were planted with 18-25 seeds based on expected germination rates, and thinned back to 9-10 plants per row at approximately the V4 growth stage and individually numbered. Inbred rows were thinned to 15-18 plants per row. Summer nursery will refer to this location in a given year. Experimental rows were planted in 4.88 m rows on .97 m spacings. Winter nursery was planted at 27 Farms in Homestead, FL, and Winter Nursery will refer to this location in a given year. Experimental lines were shoot-bagged, covering two ears when available. The silks were cut back, covered and pollinated the next morning. The top ear was pollinated with *gal* or *Gal-s* pollen from neighboring inbred lines, and, if available, the lower ear was self-

pollinated. The top ear was pollinated with *gal* or *Gal-s* pollen in order to ensure testing of resistance, while the fewer seeds often recovered from a second ear were adequate for breeding purposes. This also prevented the accumulation of selfed seed with no evaluation data. Experimental lines were also crossed as numbered males to synchronously flowering inbred lines. Thirty to forty-five days after pollination the top ears of experimental lines were evaluated for resistance to *gal* based on the number of kernels set on the father-plant ear. If the pollination set a full ear, then the self and cross(es) of that plant were discarded. If the top ear set few kernels, then the self and cross(es) of that plant were maintained, and harvested at an appropriate time. This evaluation process was repeated in both summer and winter nurseries during 2013 and 2014 by advancing materials that were putatively *gal* resistant. This material was evaluated as crosses/backcrosses between experimental lines and inbred or hybrid lines. Materials were not linearly developed, so that the numbers of accessions increased over the experiment as crosses with new accessions showing evidence of *gal* resistance were identified through development of materials in the NCSU and GEM breeding programs. It is important to note that where backcrosses are listed, the number of kernels is the number of kernels on the top ear of the donor parent plant.

An isolation block was used to evaluate material for resistance to *gal* in summer 2013. This block was planted at Central Crops Research Station in Clayton, N.C. following standard isolation protocols on April 10, 2013. The male was LH283xLH287 which produces *gal* pollen. Five delay plantings of male were planted at approximately seven day intervals to ensure adequate pollen supply to the experimental lines. Experimental lines were entered as

single 4.88m rows, 4 rows wide between two rows of male. An estimated 30 days after pollination, top ears were evaluated for number of kernels set on eight plants in each row. Where data is presented as ‘# of ears for type’, this indicates the number of ears for a resistant or segregating type (a zero indicates no ears were resistant), which will be designated in the next column, labeled ‘Seg?’, where ‘n’ is not segregating, ‘s’ is segregating, and ‘g’ is resistant to *gal*.

Tcb1+Gal-m/Tcb1+Gal-m lines were crossed and backcrossed into the mentioned NC inbreds and ex-PVP lines for up to five backcrosses, and were evaluated for maintained resistance to *gal tcb1* pollen by pollinating the top ear with such pollen.

Material for yield trials was identified through the *gal* screening process. A yield trial of twenty-six F₁ topcrosses was begun by topcrossing putative DGF-containing lines to (NC320xNC368), a hybrid. Trials were planted in 2013 in a randomized complete block design with 2 replications at 5 locations across North Carolina (Central Crops Research Station, Clayton, N.C.; Caswell Farm, Kinston, N.C.; Cunningham Research Station, Kinston, N.C.; Piedmont Research Station, Salisbury, N.C and Peanut Belt Research Station, Lewiston-Woodville, N.C.). Yield trial specifics are presented in Appendix II Table 2. Four double-cross hybrids containing one putative DGF-containing line on each side of the pedigree were produced by crossing the two lines, and were entered into this yield trial also. Four standard commercial hybrids, one double-cross hybrid without putative DGFs, and one commercial hybrid with a pollen isolating system, Blue River 71PM50, were entered as

checks, for a total of 36 entries per replication. In 2014, six entries were dropped based on DGF status and the trial was increased to 3 replications per location.

A second yield trial, containing fifty F₁S₁ putative DGF-containing lines topcrossed to NC476xHBA1, a non-stiff stalk hybrid, was placed at the same five locations in 2014 using a randomized complete block design and three replications. This trial also included four DGF containing double-cross hybrids, with DGF-containing single crosses used as male, two *Tcb1+Gal-m/Tcb1+Gal-m* topcrosses, nine BC₁ topcrosses, and seven checks, for a total of 72 entries per replication.

Results

Material from the evaluated accessions began evaluation during different years. The results will be presented by generation within accession. Material evaluated in nursery is presented with the number of kernels present on the top ear after pollination with “normal” (*gal/gal*) or *Gal-s* pollen. Some material was evaluated in an isolation block, which was detassled and the male was a “normal” (*gal/gal*) pollen parent. For this set of material, isolation short rows were evaluated and seed set counts represent the number of seed for the given number of ears observed unless otherwise noted. Where “# Ears For Type” is used, this indicates the number of kernels observed on segregating rows for pollen blocking type. In the “Seg?” column, an ‘s’ indicates segregating, a ‘g’ indicates the material is DGF-positive and ‘?’ indicates inconclusive, and “n” indicates no barrier. A number of kernels observed on 0 ears, in this case, indicates that no pollen barrier is present in this notation.

Jalisco 78

9525

9525, a row of Jalisco 78, was crossed as male to LH132 in winter nursery 2012. Seed from LH132x9525-2, where the "-2" indicates that the second plant within the original Jalisco 78 row was used as male, was planted ear-to-row in summer nursery 2013 and evaluated as described. 9525 -7 was similarly evaluated. Results are presented in Table 2.

Table 2. Results of *gal* pollination evaluation for 9525 from Jalisco 78

Description	R13 Row	Top Ear #K
LH132x9525-02/12	128-01	>50
LH132x9525-02/12	128-02	xxx
LH132x9525-02/12	128-03	0
LH132x9525-02/12	128-04	0
LH132x9525-02/12	128-05	1
LH132x9525-02/12	128-06	0
LH132x9525-02/12	128-07	7
LH132x9525-02/12	128-08	5
LH132x9525-07/12	129-01	xxx
LH132x9525-07/12	129-02	0
LH132x9525-07/12	129-03	10
LH132x9525-07/12	129-04	0
LH132x9525-07/12	129-05	0
LH132x9525-07/12	129-06	0
LH132x9525-07/12	129-07	0
LH132x9525-07/12	129-08	0

Crosses of 9525-2, 9525-7 and 9525-8 with inbred LH132 were also evaluated as rows in an isolation block in summer 2013. Results are presented in Table 3.

Table 3. Results for *gal* isolation block evaluation for 9525 from Jalisco 78

Description	#K	# Ears For Type	Seg?
6049_LH132xMaizDul-JAL78_____9501x9525-02/12	5	1	s
6050_LH132xMaizDul-JAL78_____9501x9525-07/12	1	2	s
6051_LH132xMaizDul-JAL78_____9501x9525-08/12	0	3	s

9526

Row 9526, another row of Jalisco 78 from the same source, was crossed as male to LH51, LH132 and NC368 in winter nursery 2012, then planted ear-to-row in summer nursery 2013, where the top ear was pollinated with “normal pollen” to evaluate for resistance to *gal* pollination. The crosses with LH51 were from 9526-2, 9526-4 and 9526-9. 9526-2 was also crossed to LH132 and NC368 then evaluated for *gal* resistance. Results are presented in Table 4.

Table 4. Results of *gal* pollination evaluation for 9526 from Jalisco 78

Description	R13 Row	Top Ear #K
LH51x9526-02/12	76-01	20
LH51x9526-02/12	76-02	15
LH51x9526-02/12	76-03	>50

Table 4. Continued

Description	R13 Row	Top Ear #K
LH51x9526-02/12	76-04	xxx
LH51x9526-02/12	76-05	6
LH51x9526-02/12	76-06	>50
LH51x9526-02/12	76-07	>50
LH51x9526-02/12	76-08	10
LH51x9526-02/12	76-09	>50
LH51x9526-04/12	77-01	3
LH51x9526-04/12	77-02	0
LH51x9526-04/12	77-03	0
LH51x9526-04/12	77-04	10
LH51x9526-04/12	77-05	4
LH51x9526-04/12	77-06	>50
LH51x9526-04/12	77-07	>50
LH51x9526-04/12	77-08	4
LH51x9526-04/12	77-09	>50
LH51x9526-09/12	78-01	>50
LH51x9526-09/12	78-02	>50
LH51x9526-09/12	78-03	>50
LH51x9526-09/12	78-04	30
LH51x9526-09/12	78-05	>50
LH51x9526-09/12	78-06	30
LH51x9526-09/12	78-07	>50
LH51x9526-09/12	78-08	>50
LH132x9526-02/12	130-01	0
LH132x9526-02/12	130-02	1
LH132x9526-02/12	130-03	3
LH132x9526-02/12	130-04	>50
LH132x9526-02/12	130-05	>50
LH132x9526-02/12	130-06	0
LH132x9526-02/12	130-07	0
LH132x9526-02/12	130-08	1
LH132x9526-04/12	131-01	0
LH132x9526-04/12	131-02	xxx
LH132x9526-04/12	131-03	0

Table 4. Continued

Description	R13 Row	Top Ear #K
LH132x9526-04/12	131-04	0
LH132x9526-04/12	131-05	0
LH132x9526-04/12	131-06	0
LH132x9526-04/12	131-07	0
LH132x9526-04/12	131-08	0
NC368x9526-09/12	200-01	xxx
NC368x9526-09/12	200-02	15
NC368x9526-09/12	200-03	0
NC368x9526-09/12	200-04	1
NC368x9526-09/12	200-05	3
NC368x9526-09/12	200-06	0
NC368x9526-09/12	200-07	15
NC368x9526-09/12	200-08	25
NC368x9526-09/12	200-09	4

9526-2, 9526-4, and 9526-9 crosses were also evaluated in an isolation block. 9526-2 did not segregate for any resistance to pollination by *gal*. 9526-4 had twelve kernels on eight ears and 9526-9 had sixty kernels on four plants, with the remainder being fully set. Results are presented in Table 5.

Table 5. Results of *gal* isolation block evaluation of 9526 from Jalisco 78

Description	#K	# Ears For Type	Seg?
6052_LH132xMaizDul-JAL78_____9501x9526-02/12	500	0	n
6053_LH132xMaizDul-JAL78_____9501x9526-04/12	12	8	g
6054_LH132xMaizDul-JAL78_____9501x9526-09/12	60	4	?

1161

1161, a row of (NC320xNC368)xJalisco 78, was selfed as individually numbered plants, then crossed to synchronously flowering lines in summer 2012. 1161-1 was crossed to NC320 and evaluated for resistance to *gal* pollination in winter nursery 2013. 1161-5 was crossed to both NC368 and (NC328xCML277) and evaluated for resistance to *gal* pollination. 1161-5 was also crossed to 8213, and top ears were pollinated with *gal* pollen in summer 2014. Results are presented in Table 6.

Table 6. Results of *gal* pollination evaluation of 1161 derived crosses from Jalisco 78

Description	Top Ear #K
8552x51-1 NC320*2x320/368.J78BC1_05_1158x1161-1/12	350
8552x51-2 NC320*2x320/368.J78BC1_05_1158x1161-1/12	500
8552x51-3 NC320*2x320/368.J78BC1_05_1158x1161-1/12	100
8552x51-4 NC320*2x320/368.J78BC1_05_1158x1161-1/12	350
8557x58-1 368*2x320/368.Jal78BC1_02_1165x1161-5/12	400
8557x58-2 368*2x320/368.Jal78BC1_02_1165x1161-5/12	50
8557x58-3 368*2x320/368.Jal78BC1_02_1165x1161-5/12	40
8557x58-4 368*2x320/368.Jal78BC1_02_1165x1161-5/12	120
8558-1x8528 368x320/368.Jal78BC_522_1165x1161-5/12	400
8556x55-1 328.CM277*2x320/368.J78BC_1138x1161-5/12	600
8556x55-2 328.CM277*2x320/368.J78BC_1138x1161-5/12	80
8556x55-3 328.CM277*2x320/368.J78BC_1138x1161-5/12	500
771-1 8213x1161-5_1103x1161-5/12	400
771-2 8213x1161-5_1103x1161-5/12	0
771-3 8213x1161-5_1103x1161-5/12	0
771-4 8213x1161-5_1103x1161-5/12	400
771-5 8213x1161-5_1103x1161-5/12	400
771-6 8213x1161-5_1103x1161-5/12	100
771-7 8213x1161-5_1103x1161-5/12	xxx

Table 6. Continued

Description		Top Ear #K
771-8	8213x1161-5 1103x1161-5/12	0
771-9	8213x1161-5 1103x1161-5/12	xxx

1179-6

1179-6, the sixth plant in a row of (NC476xHBA1)xJalisco 78 was crossed to both NC522 and HBA1 in summer 2012. Seed of these crosses was planted ear-to-row in winter nursery in 2012 and evaluated for *gal* resistance. Results are presented in Appendix I Table 1.

1212-1

1212-1, the first plant in a row of (NC476xHBA1)xJalisco 78, was evaluated for resistance to *gal* pollination as a single isolation row in summer 2013. This row segregated for some resistance to pollination, although it had high kernel counts on the ears. Results are presented in Table 7.

Table 7. Results of *gal* isolation block evaluation on a 1212-1 line from Jalisco 78

Description	#K on Row	# Ears Obs.	Seg?
6610_NC476/HBA1.Jal78_09_____1212-01/12	999	8	y

1212-1, the first plant in a row of (NC476xHBA1)xJalisco 78, was crossed, then backcrossed to NC296, NC522, HBA1, and NC258 in summer nursery 2012. This material was planted ear-to-row and evaluated in winter 2012. Results are presented in Appendix I Table 2.

1213

1213, a row of (NC476xHBA1)xJalisco 78, was crossed as numbered plants to standard lines in summer 2012. Material was planted ear-to-row in winter 2012 and evaluated for *gal* resistance. Results are presented in Appendix I Table 3.

1214-5

1214, the fifth plant in a row of (NC476xHBA1)xJalisco 78, was crossed to NC464 and HBA1 in summer 2012. Material was planted ear-to-row in winter 2012 and evaluated for *Gal-s* resistance. Results are presented in Appendix I Table 4.

1222

1222-3, a self of the third plant in a row of PHZ51xJalisco 78, was evaluated for resistance to *gal* pollination as a single isolation row in summer 2013. Results are presented in Table 8.

Table 8. Results of *gal* isolation evaluation on 1222-3 derived crosses from Jalisco 78

Description	#K on Row	# Ears Obs.	Seg?
6611_PHZ51xJal78_____RH132x35-c/11_1222-03/12	5	8	n

1222, a row of PHZ51xJalisco 78, was crossed to HBA1 and NC296 in summer 2012.

Material was planted ear-to-row in winter 2012 and evaluated for *gal* or *Gal-s* resistance.

Results are presented in Table 9.

Table 9. Results of *gal* evaluation on 1222-2 and 1222-3 derived crosses from Jalisco 78

Description	Top Ear #K
8541x42-1_HBA1xLH181.Z51/Jal78F1_1453x1222-2/12	600
8541x42-2_HBA1xLH181.Z51/Jal78F1_1453x1222-2/12	100
8541x42-3_HBA1xLH181.Z51/Jal78F1_1453x1222-2/12	300
8541x42-4_HBA1xLH181.Z51/Jal78F1_1453x1222-2/12	500
8508x07-1_NC296*2xZ51.Jal78_BC1_1321x1222-3/12	75
8508x07-2_NC296*2xZ51.Jal78_BC1_1321x1222-3/12	20
8508x07-3_NC296*2xZ51.Jal78_BC1_1321x1222-3/12	9
8508x07-4_NC296*2xZ51.Jal78_BC1_1321x1222-3/12	6

1222-2 was also crossed to another row of HBA1 in summer 2012, and top ears were pollinated with *gal* pollen in summer 2014. Two rows of this material were simultaneously evaluated and results are presented in Table10.

Table 10. Results of *gal* evaluation of HBA1x1222-2 derived crosses from Jalisco 78

Description	Top Ear #K
770-1_HBA1xZ51.J78_1222-2_1281x1222-2/12	19
770-2_HBA1xZ51.J78_1222-2_1281x1222-2/12	0
770-3_HBA1xZ51.J78_1222-2_1281x1222-2/12	300
770-4_HBA1xZ51.J78_1222-2_1281x1222-2/12	400

Table 10. Continued

Description	Top Ear #K
770-5_HBA1xZ51.J78_1222-2_1281x1222-2/12	400
770-6_HBA1xZ51.J78_1222-2_1281x1222-2/12	300
770-7_HBA1xZ51.J78_1222-2_1281x1222-2/12	90
770-8_HBA1xZ51.J78_1222-2_1281x1222-2/12	90
770-9_HBA1xZ51.J78_1222-2_1281x1222-2/12	21
982-1_HBA1xZ51.J78_1222-2_1281x1222-2/12	100
982-2_HBA1xZ51.J78_1222-2_1281x1222-2/12	900
982-3_HBA1xZ51.J78_1222-2_1281x1222-2/12	600
982-4_HBA1xZ51.J78_1222-2_1281x1222-2/12	500
982-5_HBA1xZ51.J78_1222-2_1281x1222-2/12	xxx
982-6_HBA1xZ51.J78_1222-2_1281x1222-2/12	700
982-7_HBA1xZ51.J78_1222-2_1281x1222-2/12	800
982-8_HBA1xZ51.J78_1222-2_1281x1222-2/12	900
982-9_HBA1xZ51.J78_1222-2_1281x1222-2/12	700
982-10_HBA1xZ51.J78_1222-2_1281x1222-2/12	900
982-11_HBA1xZ51.J78_1222-2_1281x1222-2/12	70

A LH181x1222-2 cross was previously evaluated in summer 2013. This evaluation was very different from the 2014 observation, in which none of the four plants evaluated set less than 100 kernels on the top ear. Results are presented in Table 11.

Table 11. Results of *gal* evaluation of LH182x1222-2 derived crosses from Jalisco 78

Description	R13 Row	Top Ear #K
LH181xPHZ51.Jal78_R13_1453x1222-2/12	1985-01	0
LH181xPHZ51.Jal78_R13_1453x1222-2/12	1985-02	0
LH181xPHZ51.Jal78_R13_1453x1222-2/12	1985-03	6
LH181xPHZ51.Jal78_R13_1453x1222-2/12	1985-04	0

Table 11. Continued

Description	R13 Row	Top Ear #K
LH181xPHZ51.Jal78_R13__1453x1222-2/12	1985-05	>50
LH181xPHZ51.Jal78_R13__1453x1222-2/12	1985-06	15
LH181xPHZ51.Jal78_R13__1453x1222-2/12	1985-07	>50
LH181xPHZ51.Jal78_R13__1453x1222-2/12	1985-08	0
LH181xPHZ51.Jal78_R13__1453x1222-2/12	1985-09	>50

1223

A self of 1223-10, the tenth plant in a row of PHZ51xJalisco 78 in summer 2012, was evaluated for resistance to *gal* pollination as a single isolation row in summer 2013.

Evaluation resulted in 25 kernels set on the entire row. Results are presented in Table 12.

Table 12. Results of *gal* isolation evaluation of 1223-10 from Jalisco 78

Description	#K on Row	# Ears Obs.	Seg?
6612_PHZ51xJal78____1223-10/12____1223-10/12	25	8	n

1223, a row of PHZ51xJalisco 78 in summer 2012, was crossed to NC522, 1246-1, PHN46, 1274-1 and NC296. Resulting seed was planted ear-to-row in winter nursery 2012 and evaluated for *gal* or *Gal-s* resistance. Results are presented in Table 13.

Table 13. Results of *gal* (and *Gal-s* for NC296 and NC522 crosses) evaluation of 1223 derived crosses from Jalisco 78

Description	Top Ear #K
8528x27-1_NC522*2xZ51.Jal78_BC1_1414x1223-1/12	800
8528x27-2_NC522*2xZ51.Jal78_BC1_1414x1223-1/12	900
8528x27-3_NC522*2xZ51.Jal78_BC1_1414x1223-1/12	900
8528x27-4_NC522*2xZ51.Jal78_BC1_1414x1223-1/12	999
8544x43-1_NC258*2xZ51.Jal78_BC1_1206x1223-1/12	80
8544x43-2_NC258*2xZ51.Jal78_BC1_1206x1223-1/12	25
8544x43-3_NC258*2xZ51.Jal78_BC1_1206x1223-1/12	20
8544x43-4_NC258*2xZ51.Jal78_BC1_1206x1223-1/12	1
8569x70-1_1246-1*2xZ51.Jal78_BC1_1438x1223-1/12	6
8569x70-2_1246-1*2xZ51.Jal78_BC1_1438x1223-1/12	800
8569x70-3_1246-1*2xZ51.Jal78_BC1_1438x1223-1/12	700
8569x70-4_1246-1*2xZ51.Jal78_BC1_1438x1223-1/12	800
8576x75-1_PHN46*2xZ51.Jal78_BC1_1376x1223-1/12	30
8576x75-2_PHN46*2xZ51.Jal78_BC1_1376x1223-1/12	100
8553x54-1_8213-2/05*2x51.J78_BC1_1106x1223-1/12	1
8553x54-2_8213-2/05*2x51.J78_BC1_1106x1223-1/12	700
8553x54-3_8213-2/05*2x51.J78_BC1_1106x1223-1/12	20
8553x54-4_8213-2/05*2x51.J78_BC1_1106x1223-1/12	300
8572x71-1_1274-1/02*2xZ51.J78BC_1439x1223-10/12	600
8572x71-2_1274-1/02*2xZ51.J78BC_1439x1223-10/12	700
8572x71-3_1274-1/02*2xZ51.J78BC_1439x1223-10/12	8
8572x71-4_1274-1/02*2xZ51.J78BC_1439x1223-10/12	50
8505x06-1_NC296*2xZ51.Jal78_BC1_1320x1223-10/12	700
8505x06-2_NC296*2xZ51.Jal78_BC1_1320x1223-10/12	400
8505x06-3_NC296*2xZ51.Jal78_BC1_1320x1223-10/12	500
8505x06-4_NC296*2xZ51.Jal78_BC1_1320x1223-10/12	700

1226

1226-1, 1226-2, 1226-5 and 1226-8, individual selfs in a row of PHZ51xJalisco 78 in summer 2012, were evaluated for resistance to *gal* pollination in an isolation block in summer 2013. Results are presented in Table 13.

Table 14. Results of *gal* isolation evaluation of 1226-derived lines from Jalisco 78

Description	#K on Row	# Ears Obs.	Seg?
6613_PHZ51xJ78___redRH132x35-g/11_1226-01/12	100	8	y
6614_PHZ51xJ78___redRH132x35-g/11_1226-02/12	7	8	n
6615_PHZ51xJ78_____RH132x35-g/11_1226-05/12	3	8	n
6616_PHZ51xJ78_____RH132x35-g/11_1226-08/12	2	8	n

1226, a row of PHZ51xJalisco 78 in summer 2012, was also crossed to several synchronously flowering lines and evaluated for resistance to *gal* pollination in winter nursery 2012. Results for 1226-1 are presented in Table 15, along with results from 1226-4, and 1226-5. 1226-2, the second plant in row 1226, was crossed to HBA1 and NC476 and evaluated for resistance to *gal* pollination. Results for 1226-2 are presented in Appendix I Table 5. 1226-4, the fourth plant in row 1226, was crossed to HBA1 and NC476 and evaluated for resistance to *gal* pollination. 1226-5, the fifth plant within row 1226, was crossed to HBA1 and NC476 and evaluated for resistance to *gal* pollination. 1226-8, the

eighth plant within row 1226, was crossed to NC520 and evaluated for resistance to *Gal-s* pollination. Results for 1226-2 and 1226-8 are presented in Appendix I Table 5.

Table 15. Results of *gal* or *Gal-s* evaluation of 1226 derived crosses from Jalisco 78

Description	Top Ear #K
8517x18-1 NC520*2xZ51.Jal78 BC1 1391x1226-1/12	600
8517x18-2 NC520*2xZ51.Jal78 BC1 1391x1226-1/12	700
8517x18-3 NC520*2xZ51.Jal78 BC1 1391x1226-1/12	800
8517x18-4 NC520*2xZ51.Jal78 BC1 1391x1226-1/12	75
8545x46-1 NC258*2xZ51.Jal78 BC1 1206x1226-1/12	200
8545x46-2 NC258*2xZ51.Jal78 BC1 1206x1226-1/12	450
8545x46-3 NC258*2xZ51.Jal78 BC1 1206x1226-1/12	0
8536x35-1 HBA1*2xZ51.Jal78 BC1 1218x1226-4/12	0
8536x35-2 HBA1*2xZ51.Jal78 BC1 1218x1226-4/12	450
8536x35-3 HBA1*2xZ51.Jal78 BC1 1218x1226-4/12	0
8565x66-1 NC476*2xZ51.Jal78 BC1 1176x1226-4/12	500
8565x66-2 NC476*2xZ51.Jal78 BC1 1176x1226-4/12	500
8565x66-3 NC476*2xZ51.Jal78 BC1 1176x1226-4/12	400
8565x66-4 NC476*2xZ51.Jal78 BC1 1176x1226-4/12	600
8537x38-1 HBA1*2xZ51.Jal78 BC1 1285x1226-5/12	0
8537x38-2 HBA1*2xZ51.Jal78 BC1 1285x1226-5/12	16
8537x38-3 HBA1*2xZ51.Jal78 BC1 1285x1226-5/12	3
8537x38-4 HBA1*2xZ51.Jal78 BC1 1285x1226-5/12	24
8564x63-1 NC476*2xZ51.Jal78 BC1 1176x1226-5/12	500
8564x63-2 NC476*2xZ51.Jal78 BC1 1176x1226-5/12	500
8564x63-3 NC476*2xZ51.Jal78 BC1 1176x1226-5/12	3
8564x63-4 NC476*2xZ51.Jal78 BC1 1176x1226-5/12	600

F₂S₁s**3801**

3801, a row of PHB47xJalisco 78 in summer 2012, was selfed, and ears from individual plants were planted ear-to-row into three rows the following year to be evaluated for DGFs.

Results are presented in Table 16.

Table 16. Results of *gal* evaluation of 3801 from Jalisco 78

Description	R13 Row	Top Ear #K
B47/MaizDulce-JAL78_B_F2red__3801-6/12	546-01	0
B47/MaizDulce-JAL78_B_F2red__3801-6/12	546-02	0
B47/MaizDulce-JAL78_B_F2red__3801-6/12	546-03	0
B47/MaizDulce-JAL78_B_F2red__3801-6/12	546-04	0
B47/MaizDulce-JAL78_B_F2red__3801-6/12	546-05	0
B47/MaizDulce-JAL78_B_F2red__3801-6/12	546-06	0
B47/MaizDulce-JAL78_B_F2red__3801-6/12	546-07	xxx
B47/MaizDulce-JAL78_B_F2red__3801-6/12	546-08	0
B47/MaizDulce-JAL78_B_F2org__3801-7/12	547-01	2
B47/MaizDulce-JAL78_B_F2org__3801-7/12	547-02	0
B47/MaizDulce-JAL78_B_F2org__3801-7/12	547-03	0
B47/MaizDulce-JAL78_B_F2org__3801-7/12	547-04	0
B47/MaizDulce-JAL78_B_F2org__3801-7/12	547-05	1
B47/MaizDulce-JAL78_B_F2org__3801-7/12	547-06	0
B47/MaizDulce-JAL78_B_F2org__3801-7/12	547-07	xxx
B47/MaizDulce-JAL78_B_F2org__3801-7/12	547-08	0
B47/MaizDulce-JAL78_B_F2org__3801-7/12	547-09	0
B47/MaizDulce-JAL78_B_F2red__3801-8/12	548-01	2
B47/MaizDulce-JAL78_B_F2red__3801-8/12	548-02	0

Table 16. Continued

Description	R13 Row	Top Ear #K
B47/MaizDulce-JAL78_B_F2red__3801-8/12	548-03	xxx
B47/MaizDulce-JAL78_B_F2red__3801-8/12	548-04	0
B47/MaizDulce-JAL78_B_F2red__3801-8/12	548-05	400
B47/MaizDulce-JAL78_B_F2red__3801-8/12	548-06	0
B47/MaizDulce-JAL78_B_F2red__3801-8/12	548-07	0
B47/MaizDulce-JAL78_B_F2red__3801-8/12	548-08	0
B47/MaizDulce-JAL78_B_F2red__3801-8/12	548-09	0
B47/MaizDulce-JAL78_B_F2red__3801-8/12	548-10	0

Nine 3801 selfs were also evaluated as single isolation rows in summer 2013. These results appear to be consistent with the nursery evaluation, but highlight the role of sampling within the data. Results are presented in Table 17.

Table 17. Results of *gal* isolation evaluation of 3801 from Jalisco 78

Description	#K on Row	# Ears Obs.	Seg?
6675_B47/MaizDulce-JAL78_B_F2__red__3801-2/12	0	8	n
6676_B47/MaizDulce-JAL78_B_F2__red__3801-3/12	0	8	n
6677_B47/MaizDulce-JAL78_B_F2__red__3801-4/12	0	8	n
6678_B47/MaizDulce-JAL78_B_F2__org__3801-5/12	5	8	n
6679_B47/MaizDulce-JAL78_B_F2__red__3801-6/12	0	8	n
6680_B47/MaizDulce-JAL78_B_F2__org__3801-7/12	0	8	n
6681_B47/MaizDulce-JAL78_B_F2__red__3801-8/12	50	8	y
6682_B47/MaizDulce-JAL78_B_F2__red__3801-9/12	15	8	n
6683_B47/MaizDulce-JAL78_B_F2__red__3801-10/12	100	9	y

1179

1179, a row of (NC476xHBA1)xJalisco 78 in summer 2012, was selfed and individual ears were planted ear-to-row the following year and evaluated. Results for 1179-2 are presented in Table 18. Results for 1179-6 are presented in Appendix I Table 6.

Table 18. Results of *gal* isolation evaluation of 1179-2 derived lines from Jalisco 78

Description	#K on Row	# Ears Obs.	Seg?
6651_NC476.HBA1xJ78_1179-02/12_F2___8356-2/12	4	8	n
6652_NC476.HBA1xJ78_1179-02/12_F2___8356-3/12	50	8	y
6653_NC476.HBA1xJ78_1179-02/12_F2___8356-4/12	0	6	n

1179-2, from the same source as isolation row 6653 (Table 18), was also evaluated for blockage of *gal* pollen in summer nursery 2014. Only four total top ears were pollinated with *gal*, of which three were completely bare and one set four kernels, aligning with the original isolation observation. Results are presented in Table 19.

Table 19. Results of *gal* evaluation of 1179-2 from Jalisco 78

Description	Top Ear #K
676-2_NC476.HBA1xJ78_1179-02/12_F2_8356-4/12	0
676-3_NC476.HBA1xJ78_1179-02/12_F2_8356-4/12	xxx
676-4_NC476.HBA1xJ78_1179-02/12_F2_8356-4/12	xxx
676-5_NC476.HBA1xJ78_1179-02/12_F2_8356-4/12	0

Table 19. Continued

Description	Top Ear #K
697-1_NC476.HBA1xJ78_1179-2/12_F2__8356-4/12	0
697-2_NC476.HBA1xJ78_1179-2/12_F2__8356-4/12	xxx
697-3_NC476.HBA1xJ78_1179-2/12_F2__8356-4/12	xxx
697-4_NC476.HBA1xJ78_1179-2/12_F2__8356-4/12	4

1161-5

1161-5, the fifth plant in a row of (NC320xNC368)xJalisco 78 in summer 2012, was selfed twice and the selfs of those plants were planted ear-to-row and evaluated in an isolation block during summer 2013. Results are presented in Table 20.

Table 20. Results of *gal* isolation evaluation of 1161-5 derived lines from Jalisco 78

Description	#K on Row	# Ears Obs.	Seg?
6636_320.368xJ78_re161-05/12_F2S1__8346-2/12	20	8	n
6637_320.368xJ78_re161-05/12_F2S1__8346-3/12	0	8	n
6638_320.368xJ78_re161-05/12_F2S1__8346-4/12	0	8	n

1212-1

1212-1 comes from the first plant in a row of (NC476xHBA1)xJalisco 78 in summer 2012, which was then crossed to HBA1, and then selfed in winter 2012. Selfed seed was planted

ear-to-row and evaluated for resistance to *gal* pollination in an isolation block during summer 2013. Results are presented in Appendix I Table 7.

1214-5

1214-5 comes from the fifth plant in a row of (NC476xHBA1)xJalisco 78 in summer 2012, which was selfed, planted ear-to-row and selfed once more during winter 2012. Seed from each of the final selfs was planted ear-to-row and evaluated in an isolation block during summer 2013. Results are presented in Table 21.

Table 21. Results of *gal* isolation evaluation of 1214-5 derived lines from Jalisco 78

Description	#K on Row	# Ears Obs.	Seg?
6639_476.HBA1xJ78blk1214-05/12_F2S1__8347-6/12	999	8	y
6640_476.HBA1xJ78blk1214-05/12_F2S1_8347-7/12	0	8	n
6641_476.HBA1xJ78blk1214-05/12_F2S1__8347-8/12	0	8	n

1214-5, from the same source as isolation row 6641 (Table 21), was also evaluated for blockage of *gal* pollen in the nursery in summer 2014. A second row from the same source was simultaneously evaluated for blockage of *gal* pollen in the nursery. The majority of these two rows did not set seed, aligning with the isolation observations. Results are presented in Table 22.

Table 22. Results of *gal* evaluation of 1214-5 derived lines from Jalisco 78

Description	Top Ear #K
677-1_476.HBA1xJ78blk_1214-5/12_F2S1_8347-8/12	xxx
677-2_476.HBA1xJ78blk_1214-5/12_F2S1_8347-8/12	0
677-3_476.HBA1xJ78blk_1214-5/12_F2S1_8347-8/12	0
677-4_476.HBA1xJ78blk_1214-5/12_F2S1_8347-8/12	0
677-5_476.HBA1xJ78blk_1214-5/12_F2S1_8347-8/12	0
677-6_476.HBA1xJ78blk_1214-5/12_F2S1_8347-8/12	xxx
677-7_476.HBA1xJ78blk_1214-5/12_F2S1_8347-8/12	0
677-8_476.HBA1xJ78blk_1214-5/12_F2S1_8347-8/12	0
700-1_476.HBA1xJ78blk_1214-5/12_F2_8347-8/12	0
700-2_476.HBA1xJ78blk_1214-5/12_F2_8347-8/12	0
700-3_476.HBA1xJ78blk_1214-5/12_F2_8347-8/12	0
700-4_476.HBA1xJ78blk_1214-5/12_F2_8347-8/12	xxx
700-6_476.HBA1xJ78blk_1214-5/12_F2_8347-8/12	0
700-7_476.HBA1xJ78blk_1214-5/12_F2_8347-8/12	200
700-8_476.HBA1xJ78blk_1214-5/12_F2_8347-8/12	xxx
700-9_476.HBA1xJ78blk_1214-5/12_F2_8347-8/12	xxx

1222-2

1222-2, the second plant in a row of PHZ51xJalisco 78 in summer 2012, was selfed twice, planted ear-to-row in an isolation block in summer 2013, and evaluated for resistance to *gal* pollination. Results are presented in Table 23.

Table 23. Results of *gal* isolation evaluation of 1222-2 derived lines from Jalisco 78

Description	#K on Row	# Ears Obs.	Seg?
6642_PHZ51xJal78_wh_1222-02/12_F2__8348-10/12	25	8	y
6643_PHZ51xJal78____1222-02/12_F2__8348-11/12	0	8	n
6644_PHZ51xJal78____1222-02/12_F2__8348-12/12	1	8	n

1223

1223, a row of PHZ51xJalisco 78 in summer 2012, was selfed twice, planted ear-to-row and evaluated in an isolation block during summer 2013. Three rows each from 1223-1, -2, -6, and two rows from 1223-9 were evaluated, all of which were uniformly resistant. Results are presented in Table 24.

Table 24. Results of *gal* evaluation of 1223 derived lines from Jalisco 78

Description	#K on Row	# Ears Obs.	Seg?
6645_PHZ51xJal78__1223-01/12_F2S1__8349-8/12	0	8	n
6646_PHZ51xJ78____1223-01F2S1_8349-9/12	0	8	n
6647_PHZ51xJal78__1223-01/12_F2S1__8349-10/12	0	4	n
6657_PHZ51xJal78org_1223-02/12_F2S1__8358-5/12	0	8	n
6658_PHZ51xJal78org_1223-02/12_F2S1__8358-6/12	0	8	n
6659_PHZ51xJal78red_1223-02/12_F2S1__8358-7/12	0	8	n
6660_PHZ51xJal78red_1223-06/12_F2S1__8359-4/12	0	8	n
6661_PHZ51xJal78red_1223-06/12_F2S1__8359-5/12	0	8	n
6662_PHZ51xJal78red_1223-06/12_F2S1_8359-6/12	0	8	n
6663_PHZ51xJal78____1223-09/12_F2S1__8360-1/12	0	8	n
6664_PHZ51xJal78__org1223-09/12_F2S1__8360-2/12	0	8	n

1223-1, from the same source as isolation row 6646 (Table 24), was also evaluated for blockage of *gal* pollen in two individual nursery rows during summer 2014. These rows were uniformly resistant, aligning with the isolation observation. Results are presented in Table 25.

Table 25. Results of *gal* isolation evaluation of 1223-1(8349-8) F₂S₁ lines from Jalisco 78

Description	Top Ear #K
680-3_PHZ51xJ78__su1223-01/12_F2S1__8349-8/12	0
680-4_PHZ51xJ78__su1223-01/12_F2S1__8349-8/12	xxx
680-5_PHZ51xJ78__su1223-01/12_F2S1__8349-8/12	0
680-6_PHZ51xJ78__su1223-01/12_F2S1__8349-8/12	0
680-7_PHZ51xJ78__su1223-01/12_F2S1__8349-8/12	0
680-8_PHZ51xJ78__su1223-01/12_F2S1__8349-8/12	0
680-9_PHZ51xJ78__su1223-01/12_F2S1__8349-8/12	0
701-1_PHZ51xJal78__su_1223-1/12_F2S1__8349-8/12	0
701-2_PHZ51xJal78__su_1223-1/12_F2S1__8349-8/12	0
701-3_PHZ51xJal78__su_1223-1/12_F2S1__8349-8/12	0
701-4_PHZ51xJal78__su_1223-1/12_F2S1__8349-8/12	0
701-5_PHZ51xJal78__su_1223-1/12_F2S1__8349-8/12	0
701-6_PHZ51xJal78__su_1223-1/12_F2S1__8349-8/12	0
701-7_PHZ51xJal78__su_1223-1/12_F2S1__8349-8/12	0
701-8_PHZ51xJal78__su_1223-1/12_F2S1__8349-8/12	0
701-9_PHZ51xJal78__su_1223-1/12_F2S1__8349-8/12	xxx

1223-1 was also evaluated for blockage of *gal* pollen in two individual nursery rows from the same source as isolation row 6647 (Table 24). These two summer 2014 rows were uniformly bare, aligning with the isolation observation. Results are presented in Table 26.

Table 26. Results of additional *gal* evaluation of 1223-1(8349-9) F₂S₁ lines from Jalisco 78

Description	Top Ear #K
681-1_PHZ51xJ78prqul_1223-01F2S1_su_8349-9/12	0
681-2_PHZ51xJ78prqul_1223-01F2S1_su_8349-9/12	0
681-3_PHZ51xJ78prqul_1223-01F2S1_su_8349-9/12	0
681-4_PHZ51xJ78prqul_1223-01F2S1_su_8349-9/12	0
681-5_PHZ51xJ78prqul_1223-01F2S1_su_8349-9/12	0
681-6_PHZ51xJ78prqul_1223-01F2S1_su_8349-9/12	0
681-7_PHZ51xJ78prqul_1223-01F2S1_su_8349-9/12	0
681-8_PHZ51xJ78prqul_1223-01F2S1_su_8349-9/12	0
704-1_PHZ51xJ78_prqua_1223-01F2S1su_8349-9/12	0
704-2_PHZ51xJ78_prqua_1223-01F2S1su_8349-9/12	xxx
704-3_PHZ51xJ78_prqua_1223-01F2S1su_8349-9/12	0
704-4_PHZ51xJ78_prqua_1223-01F2S1su_8349-9/12	0
704-5_PHZ51xJ78_prqua_1223-01F2S1su_8349-9/12	0
704-6_PHZ51xJ78_prqua_1223-01F2S1su_8349-9/12	0
704-7_PHZ51xJ78_prqua_1223-01F2S1su_8349-9/12	1
704-8_PHZ51xJ78_prqua_1223-01F2S1su_8349-9/12	0
704-9_PHZ51xJ78_prqua_1223-01F2S1su_8349-9/12	0

1223-2 was also evaluated for blockage of *gal* pollen in two individual nursery rows from the same source as isolation row 6659 (Table 24). These two summer 2014 rows were uniformly bare, aligning with the isolation observation. Results are presented in Table 27.

Table 27. Results of *gal* evaluation of 1223-2 F₂S₁ lines from Jalisco 78

Description	Top Ear #K
684-1_PHZ51xJal78red_1223-02/12F2S1_8358-7/12	0
684-2_PHZ51xJal78red_1223-02/12F2S1_8358-7/12	0

Table 27. Continued

Description	Top Ear #K
684-3_PHZ51xJal78red_1223-02/12F2S1_8358-7/12	xxx
684-4_PHZ51xJal78red_1223-02/12F2S1_8358-7/12	0
684-5_PHZ51xJal78red_1223-02/12F2S1_8358-7/12	xxx
705-1_PHZ51xJal78red_1223-2/12_F2S1_8358-7/12	0
705-3_PHZ51xJal78red_1223-2/12_F2S1_8358-7/12	0
705-4_PHZ51xJal78red_1223-2/12_F2S1_8358-7/12	0
705-5_PHZ51xJal78red_1223-2/12_F2S1_8358-7/12	0
705-6_PHZ51xJal78red_1223-2/12_F2S1_8358-7/12	0

1223-9 was also evaluated for blockage of *gal* pollen in two individual nursery rows from the same source, isolation row 6663 (Table 24). These two summer 2014 rows were uniformly bare, aligning with the isolation observation. Results are presented in Table 28.

Table 28. Results of *gal* evaluation of 1223-9 F₂S₁ lines from Jalisco 78

Description	Top Ear #K
685-1_PHZ51xJal78_1223-09/12_F2S1_8360-1/12	0
685-2_PHZ51xJal78_1223-09/12_F2S1_8360-1/12	0
685-3_PHZ51xJal78_1223-09/12_F2S1_8360-1/12	0
685-4_PHZ51xJal78_1223-09/12_F2S1_8360-1/12	0
685-5_PHZ51xJal78_1223-09/12_F2S1_8360-1/12	0
685-6_PHZ51xJal78_1223-09/12_F2S1_8360-1/12	1
685-7_PHZ51xJal78_1223-09/12_F2S1_8360-1/12	0
685-8_PHZ51xJal78_1223-09/12_F2S1_8360-1/12	0
685-9_PHZ51xJal78_1223-09/12_F2S1_8360-1/12	0
708-1_PHZ51xJal78_1223-09_su_F2S1_8360-1/12	0
708-2_PHZ51xJal78_1223-09_su_F2S1_8360-1/12	0
708-3_PHZ51xJal78_1223-09_su_F2S1_8360-1/12	0

Table 28. Continued

Description	Top Ear #K
708-4_PHZ51xJal78__1223-09_su_F2S1__8360-1/12	0
708-5a_PHZ51xJal78__1223-09_suF2S1__8360-1/12	0
708-5b_PHZ51xJal78__1223-09_suF2S1__8360-1/12	0
708-5_PHZ51xJal78__1223-09_su_F2S1__8360-1/12	0
708-6_PHZ51xJal78__1223-09_su_F2S1__8360-1/12	0
708-7_PHZ51xJal78__1223-09_su_F2S1__8360-1/12	0
708-9_PHZ51xJal78__1223-09_su_F2S1__8360-1/12	0

1226

1226, a row of PHZ51xJalisco 78 in the summer 2012 nursery, was selfed twice, planted ear-to-row in an isolation block in summer 2013 and evaluated for resistance to *gal* pollination.

Three such rows from each of 1226-4, 1226-6, 1226-7, and 1226-9 were evaluated and results are presented in Table 29.

Table 29. Results of *gal* isolation block evaluation of 1226 F₂S₁ lines from Jalisco 78

Description	#K on Row	# Ears Obs.	Seg?
6648_PHZ51xJ78_red__1226-04/12_F2S1__8351-8/12	0	8	n
6649_PHZ51xJ78____1226-04/12_F2S1__8351-9/12	0	8	n
6650_PHZ51xJ78_sure226-04/12_F2S1__8351-10/12	0	8	n
6654_PHZ51xJ78_red__1226-06/12_F2S1__8357-5/12	0	8	n
6655_PHZ51xJ78_redsu1226-06/12_F2S1__8357-6/12	0	8	n
6656_PHZ51xJ78_org__1226-06/12_F2S1__8357-7/12	0	8	n
6665_PHZ51xJal78____1226-07/12_F2S1su_8361-6/12	0	8	n
6666_PHZ51xJal78____1226-07/12_F2S1su_8361-7/12	0	8	n

Table 29. Continued

Description	#K on Row	# Ears Obs.	Seg?
6667_PHZ51xJal78__ 1226-07/12_F2S1su_ 8361-8/12	0	8	n
6668_PHZ51xJal78__ 1226-09/12_F2S1__ 8362-4/12	0	8	n
6669_PHZ51xJal78__ 1226-09/12_F2S1__ 8362-5/12	0	8	n
6670_PHZ51xJal78__ 1226-09/12_F2S1__ 8362-6/12	0	8	n

1226-4 was also evaluated for blockage of *gal* pollen in two individual nursery rows from the same source as isolation row 6649 (Table 29). The results of these two summer 2014 rows show weakened barrier strength compared to the isolation observation in row 688 but the observations align with the isolation observations in row 709. Results are presented in Table 30.

Table 30. Results of *gal* nursery evaluation of 1226-4 F₂S₁ lines from Jalisco 78

Description	Top Ear #K
688-1_PHZ51xJ78__ 1226-04/12_F2S1__ 8351-9/12	xxx
688-2_PHZ51xJ78__ 1226-04/12_F2S1__ 8351-9/12	5
688-3_PHZ51xJ78__ 1226-04/12_F2S1__ 8351-9/12	0
688-4_PHZ51xJ78__ 1226-04/12_F2S1__ 8351-9/12	10
688-5_PHZ51xJ78__ 1226-04/12_F2S1__ 8351-9/12	0
688-6_PHZ51xJ78__ 1226-04/12_F2S1__ 8351-9/12	0
688-7_PHZ51xJ78__ 1226-04/12_F2S1__ 8351-9/12	xxx
688-8_PHZ51xJ78__ 1226-04/12_F2S1__ 8351-9/12	xxx
688-9_PHZ51xJ78__ 1226-04/12_F2S1__ 8351-9/12	23
709-1_PHZ51xJ78__ 1226-04/12_F2S1__ 8351-9/12	0
709-2_PHZ51xJ78__ 1226-04/12_F2S1__ 8351-9/12	xxx
709-3_PHZ51xJ78__ 1226-04/12_F2S1__ 8351-9/12	0

Table 30. Continued

Description	Top Ear #K
709-4_PHZ51xJ78__1226-04/12_F2S1__8351-9/12	0
709-4_PHZ51xJ78__1226-04/12_F2S1__8351-9/12	0
709-5_PHZ51xJ78__1226-04/12_F2S1__8351-9/12	0
709-6_PHZ51xJ78__1226-04/12_F2S1__8351-9/12	0
709-7_PHZ51xJ78__1226-04/12_F2S1__8351-9/12	0
709-8_PHZ51xJ78__1226-04/12_F2S1__8351-9/12	xxx
709-9_PHZ51xJ78__1226-04/12_F2S1__8351-9/12	0

1226-9 was also evaluated for blockage of *gal* pollen in two individual nursery rows from the same source as isolation row 6668 (Table 29). The results of these two summer 2014 rows align with the isolation observation. Results are presented in Table 31.

Table 31. Results of *gal* nursery evaluation of 1226-9(8362-4) F₂S₁ lines from Jalisco 78

Description	Top Ear #K
689-1_PHZ51xJal78__1226-09/12_F2S1__8362-4/12	0
689-2_PHZ51xJal78__1226-09/12_F2S1__8362-4/12	1
689-3_PHZ51xJal78__1226-09/12_F2S1__8362-4/12	0
712-5_PHZ51xJal78__1226-09/12_F2__8362-4/12	0
712-6_PHZ51xJal78__1226-09/12_F2__8362-4/12	0
712-7_PHZ51xJal78__1226-09/12_F2__8362-4/12	xxx
712-8_PHZ51xJal78__1226-09/12_F2__8362-4/12	0

1226-9 was also evaluated for blockage of *gal* pollen as two rows in the 2014 nursery from the same source as isolation row 6669 (Table 29). These rows produced uniformly bare ears, aligning with the isolation observation. Results are presented in Table 32.

Table 32. Results of additional *gal* nursery evaluation of 1226-9(8362-5) F₂S₁ lines from Jalisco 78

Description	Top Ear #K
692-1_PHZ51xJal78_1226-09/12_F2S1_8362-5/12	xxx
692-2_PHZ51xJal78_1226-09/12_F2S1_8362-5/12	0
692-3_PHZ51xJal78_1226-09/12_F2S1_8362-5/12	0
692-4_PHZ51xJal78_1226-09/12_F2S1_8362-5/12	0
692-5_PHZ51xJal78_1226-09/12_F2S1_8362-5/12	1
692-6_PHZ51xJal78_1226-09/12_F2S1_8362-5/12	0
692-7_PHZ51xJal78_1226-09/12_F2S1_8362-5/12	0
692-8_PHZ51xJal78_1226-09/12_F2S1_8362-5/12	0
692-9_PHZ51xJal78_1226-09/12_F2S1_8362-5/12	0
713-1_PHZ51xJal78_1226-09/12_F2_8362-5/12	0
713-2_PHZ51xJal78_1226-09/12_F2_8362-5/12	0
713-3_PHZ51xJal78_1226-09/12_F2_8362-5/12	xxx
713-4_PHZ51xJal78_1226-09/12_F2_8362-5/12	0
713-5_PHZ51xJal78_1226-09/12_F2_8362-5/12	0
713-6_PHZ51xJal78_1226-09/12_F2_8362-5/12	0
713-7_PHZ51xJal78_1226-09/12_F2_8362-5/12	0
713-8_PHZ51xJal78_1226-09/12_F2_8362-5/12	0
713-9_PHZ51xJal78_1226-09/12_F2_8362-5/12	0

F_{3:1}S

1222

Individual plants in row 1222 were numbered and selfed. 1222-2 was then selfed twice and crossed to PHN46 and PHP38 to produce F₃-derived F₁S in summer 2013, which were pollinated with *gal* pollen on the top ear in the 2014 summer nursery. This evaluation is the first for this specific seed source, but it is derived from another plant selected from the source of isolation rows 6642-6644 (Table 29), all of which had low seed set. Results are presented in Table 33.

Table 33. Results of *gal* nursery evaluation of PHN46 and PHP38x1222-2(298-i and j) F_{3:1} crosses from Jalisco 78

Description	Top Ear #K
774-1_PHN46xZ51.J78_1222-2_8348-1_301x298-i/13	0
774-2_PHN46xZ51.J78_1222-2_8348-1_301x298-i/13	0
774-3_PHN46xZ51.J78_1222-2_8348-1_301x298-i/13	0
774-4_PHN46xZ51.J78_1222-2_8348-1_301x298-i/13	0
774-5_PHN46xZ51.J78_1222-2_8348-1_301x298-i/13	0
774-6_PHN46xZ51.J78_1222-2_8348-1_301x298-i/13	0
774-7_PHN46xZ51.J78_1222-2_8348-1_301x298-i/13	0
774-8_PHN46xZ51.J78_1222-2_8348-1_301x298-i/13	0
774-9_PHN46xZ51.J78_1222-2_8348-1_301x298-i/13	0
779-1_PHP38xZ51.J78_1222-2_8348-1_316x298-j/13	0
779-2_PHP38xZ51.J78_1222-2_8348-1_316x298-j/13	0
779-2_PHP38xZ51.J78_1222-2_8348-1_316x298-j/13	0
779-3_PHP38xZ51.J78_1222-2_8348-1_316x298-j/13	0
779-4_PHP38xZ51.J78_1222-2_8348-1_316x298-j/13	0
779-5_PHP38xZ51.J78_1222-2_8348-1_316x298-j/13	2
779-6_PHP38xZ51.J78_1222-2_8348-1_316x298-j/13	0

Table 33. Continued

Description	Top Ear #K
779-6_PHP38xZ51.J78_1222-2_8348-1_316x298-j/13	0
779-7_PHP38xZ51.J78_1222-2_8348-1_316x298-j/13	0
779-8_PHP38xZ51.J78_1222-2_8348-1_316x298-j/13	0
779-9_PHP38xZ51.J78_1222-2_8348-1_316x298-j/13	xxx

Another source of seed, derived from the second plant in the source of row 8348 (Table 29), was similarly derived and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 34.

Table 34. Results of *gal* nursery evaluation of 1222-2(299-a) F_{3:1} crosses from Jalisco 78

Description	Top Ear #K
775-1_PHN46xZ51.J78_1222-2_8348-2_301x299-a/13	0
775-2_PHN46xZ51.J78_1222-2_8348-2_301x299-a/13	0
775-3_PHN46xZ51.J78_1222-2_8348-2_301x299-a/13	0
775-4_PHN46xZ51.J78_1222-2_8348-2_301x299-a/13	0
775-5_PHN46xZ51.J78_1222-2_8348-2_301x299-a/13	0
775-6_PHN46xZ51.J78_1222-2_8348-2_301x299-a/13	0
775-7_PHN46xZ51.J78_1222-2_8348-2_301x299-a/13	0
775-8_PHN46xZ51.J78_1222-2_8348-2_301x299-a/13	0
775-8_PHN46xZ51.J78_1222-2_8348-2_301x299-a/13	0
775-9_PHN46xZ51.J78_1222-2_8348-2_301x299-a/13	0

Another source of seed, derived from the source of the third plant in the row 8348 (Table 29), was similarly derived and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 35.

Table 35. Results of *gal* nursery evaluation of 1222-2(300-a) F_{3:1} crosses from Jalisco 78

Description	Top Ear #K
778-1_PHN46xZ51.J78_1222-2_8348-3_301x300-a/13	0
778-2_PHN46xZ51.J78_1222-2_8348-3_301x300-a/13	0
778-3_PHN46xZ51.J78_1222-2_8348-3_301x300-a/13	0
778-4_PHN46xZ51.J78_1222-2_8348-3_301x300-a/13	0
778-5_PHN46xZ51.J78_1222-2_8348-3_301x300-a/13	9
778-6_PHN46xZ51.J78_1222-2_8348-3_301x300-a/13	0
778-7_PHN46xZ51.J78_1222-2_8348-3_301x300-a/13	0
778-8_PHN46xZ51.J78_1222-2_8348-3_301x300-a/13	0
778-9_PHN46xZ51.J78_1222-2_8348-3_301x300-a/13	0

1222-2 was also selfed twice to produce F₂S₁S, which were then crossed as male to NC296, a line known to contain *Gal-s*, in winter 2013 and evaluated for resistance to *Gal-s* pollination in summer nursery 2014. Results are presented in Table 36.

Table 36. Results of *gal* nursery evaluation of NC296x1222-2 F_{3:1} crosses from Jalisco 78

Description	Top Ear #K
649-1_296xZ51.J78w1222-2S2 299_8474x8411-a/13	0
649-2_296xZ51.J78w1222-2S2 299_8474x8411-a/13	36
649-3_296xZ51.J78w1222-2S2 299_8474x8411-a/13	18
649-4_296xZ51.J78w1222-2S2 299_8474x8411-a/13	35
649-5_296xZ51.J78w1222-2S2 299_8474x8411-a/13	4
649-6_296xZ51.J78w1222-2S2 299_8474x8411-a/13	42
649-7_296xZ51.J78w1222-2S2 299_8474x8411-a/13	27
649-8_296xZ51.J78w1222-2S2 299_8474x8411-a/13	0
649-9_296xZ51.J78w1222-2S2 299_8474x8411-a/13	0

1223

1223-1 was also selfed twice to produce F₂S₁s, which were then crossed to NC296, a line known to contain *Gal-s*, in winter nursery 2013 and evaluated for resistance *Gal-s* pollination in summer nursery 2014. Results are presented in Appendix I Table 8.

BC₂s

1223

1223-10, a self of the tenth plant in a row of PHZ51xJalisco 78 in summer 2012, was crossed to 1274-1 twice, selfed once and then crossed as numbered plants to 1274-1 once more in winter 2013 to produce pseudo-BC₂s. A second row of the same material was evaluated simultaneously. Results are presented in Table 37.

Table 37. Results of *gal* nursery evaluation of 1223-10 BC₂ crosses from Jalisco 78

Description	Top Ear #K
645-1_1274-1/*3xZ51.J78_23-10_001_8482x81-1/13	300
645-2_1274-1/*3xZ51.J78_23-10_001_8482x81-1/13	0
645-3_1274-1/*3xZ51.J78_23-10_001_8482x81-1/13	0
645-4_1274-1/*3xZ51.J78_23-10_001_8482x81-1/13	250
645-5_1274-1/*3xZ51.J78_23-10_001_8482x81-1/13	75
645-6_1274-1/*3xZ51.J78_23-10_001_8482x81-1/13	300
645-7_1274-1/*3xZ51.J78_23-10_001_8482x81-1/13	0
645-8_1274-1/*3xZ51.J78_23-10_001_8482x81-1/13	100
645-9_1274-1/*3xZ51.J78_23-10_001_8482x81-1/13	0
648-1_1274-1/*3xZ51.J78_23-10_000_8482x81-5/13	0
648-2_1274-1/*3xZ51.J78_23-10_000_8482x81-5/13	0
648-3_1274-1/*3xZ51.J78_23-10_000_8482x81-5/13	25

Table 37. Continued

Description	Top Ear #K
648-4_1274-1/*3xZ51.J78_23-10_000_8482x81-5/13	3
648-5_1274-1/*3xZ51.J78_23-10_000_8482x81-5/13	200
648-6_1274-1/*3xZ51.J78_23-10_000_8482x81-5/13	33
648-7_1274-1/*3xZ51.J78_23-10_000_8482x81-5/13	0
648-8_1274-1/*3xZ51.J78_23-10_000_8482x81-5/13	0
648-9_1274-1/*3xZ51.J78_23-10_000_8482x81-5/13	8

1226-5

1226-5, a self of the fifth plant in a row of PHZ51xJalisco 78 in summer 2012, was crossed to NC476 twice, selfed once and then crossed as numbered plants to NC476 once more during winter nursery 2013 to produce pseudo-BC₂s. Rows from 8480-5 and 8480-6 were simultaneously evaluated for resistance to *gal* pollination during summer 2014. Results are presented in Table 38.

Table 38. Results of *gal* nursery evaluation of 1226-5 BC₂ crosses from Jalisco 78

Description	Top Ear #K
640-1_NC476*3xZ51.J78_1226-5_000_8479x80-1/13	33
640-2_NC476*3xZ51.J78_1226-5_000_8479x80-1/13	0
640-3_NC476*3xZ51.J78_1226-5_000_8479x80-1/13	4
640-4_NC476*3xZ51.J78_1226-5_000_8479x80-1/13	0
640-5_NC476*3xZ51.J78_1226-5_000_8479x80-1/13	1
640-6_NC476*3xZ51.J78_1226-5_000_8479x80-1/13	30
640-7_NC476*3xZ51.J78_1226-5_000_8479x80-1/13	0
640-8_NC476*3xZ51.J78_1226-5_000_8479x80-1/13	0
640-9_NC476*3xZ51.J78_1226-5_000_8479x80-1/13	0

Table 38. Continued

Description	Top Ear #K
641-1_NC476*3xZ51.J78_1226-5_002_8479x80-5/13	0
641-1_NC476*3xZ51.J78_1226-5_002_8479x80-5/13	0
641-2_NC476*3xZ51.J78_1226-5_002_8479x80-5/13	14
641-3_NC476*3xZ51.J78_1226-5_002_8479x80-5/13	4
641-4_NC476*3xZ51.J78_1226-5_002_8479x80-5/13	0
641-5_NC476*3xZ51.J78_1226-5_002_8479x80-5/13	5
641-6_NC476*3xZ51.J78_1226-5_002_8479x80-5/13	0
641-7_NC476*3xZ51.J78_1226-5_002_8479x80-5/13	0
641-7_NC476*3xZ51.J78_1226-5_002_8479x80-5/13	0
641-8_NC476*3xZ51.J78_1226-5_002_8479x80-5/13	0
641-9_NC476*3xZ51.J78_1226-5_002_8479x80-5/13	0
644-1_NC476*3xZ51.J78_1226-5_001_8479x80-6/13	2
644-2_NC476*3xZ51.J78_1226-5_001_8479x80-6/13	18
644-3_NC476*3xZ51.J78_1226-5_001_8479x80-6/13	0
644-4_NC476*3xZ51.J78_1226-5_001_8479x80-6/13	0
644-5_NC476*3xZ51.J78_1226-5_001_8479x80-6/13	0
644-6_NC476*3xZ51.J78_1226-5_001_8479x80-6/13	3
644-7_NC476*3xZ51.J78_1226-5_001_8479x80-6/13	1
644-8_NC476*3xZ51.J78_1226-5_001_8479x80-6/13	35
644-9_NC476*3xZ51.J78_1226-5_001_8479x80-6/13	1

Jalisco 300**F₂s**

Three F₂ sources were evaluated for resistance to pollination by *gal* in an isolation block during summer 2013. Evaluation of 1228-1 resulted in 50 kernels set on the row, and there was segregation on amount of set within row. Evaluation of 1231-2 resulted in forty kernels

set on the row, and there was segregation on amount of set within row. Evaluation of 1231-4 resulted in zero kernels set on the row, and set was uniform. Results are presented in Table 39.

Table 39. Results of *gal* isolation block evaluation of Jalisco 300 F₂ lines

Description	#K On Row	# Ears Obs.	Seg?
6617_476.HBA1xJ300_____1228-01/12	50	8	y
6618_476.HBA1xJ300_____1231-02/12	40	8	y
6619_476.HBA1xJ300_____1231-04/12	0	8	n

1228-2

1228, a row of (NC476xHBA1)xJalisco 300, was selfed twice, and planted ear-to-row, where it was evaluated for resistance to *gal* pollination in summer nursery 2014. Two rows of the same material were evaluated, giving identical results, which are presented in Table 40.

Table 40. Results of *gal* nursery evaluation of 1228-2 F₂S₁ lines from Jalisco 300

Description	Top Ear #K
693-1_476.HBA1xJ300__1228-02__F2S1__8363-3/12	0
693-2_476.HBA1xJ300__1228-02__F2S1__8363-3/12	0
693-4_476.HBA1xJ300__1228-02__F2S1__8363-3/12	0
693-5_476.HBA1xJ300__1228-02__F2S1__8363-3/12	0
693-6_476.HBA1xJ300__1228-02__F2S1__8363-3/12	0
693-7_476.HBA1xJ300__1228-02__F2S1__8363-3/12	0
693-8_476.HBA1xJ300__1228-02__F2S1__8363-3/12	0

Table 40. Continued

Description	Top Ear #K
716-1_476.HBA1xJ300_1228-02_F2S1_8363-3/12	0
716-2_476.HBA1xJ300_1228-02_F2S1_8363-3/12	0
716-3_476.HBA1xJ300_1228-02_F2S1_8363-3/12	0
716-4_476.HBA1xJ300_1228-02_F2S1_8363-3/12	0
716-5_476.HBA1xJ300_1228-02_F2S1_8363-3/12	0
716-6_476.HBA1xJ300_1228-02_F2S1_8363-3/12	0
716-8_476.HBA1xJ300_1228-02_F2S1_8363-3/12	0
716-9_476.HBA1xJ300_1228-02_F2S1_8363-3/12	0

The original 1228-2 F₂S₁ source and a sister plant were evaluated for resistance to *gal* pollination in an isolation block in summer 2013. Observations of these two rows showed that they aligned with the 2014 observation. Results are presented in Table 41.

Table 41. Results of *gal* isolation block evaluation of 1228-2 F₂ lines from Jalisco 300

Description	#K On Row	# Ears Obs.	Seg?
6671_476.HBA1xJ300_1228-02/12_F2S1_8363-3/12	0	8	n
6673_476.HBA1xJ300_1228-02/12_F2_8363-5/12	0	8	n

1231-4

1231, a row of (NC476xHBA1)xJalisco 300, was selfed twice, and planted ear-to-row in summer 2014, where it was evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 42.

Table 42. Results of *gal* isolation block evaluation of 1231-4 F₂ lines from Jalisco 300

Description	Top Ear #K
696-1_476.HBA1xJ300_____1231-04/12	xxx
696-2_476.HBA1xJ300_____1231-04/12	85
696-3_476.HBA1xJ300_____1231-04/12	0

F_{2:1}

1228-2

The first plant in a row of 1228-2 was crossed to NC296, a line known to contain *Gal-s*, planted ear-to-row and then evaluated for resistance to pollination by *Gal-s* in summer nursery 2014. Results are presented in Table 43.

Table 43. Results of *Gal* nursery evaluation of NC296x1228-2 F_{2:1} crosses from Jalisco 300

Description	Top Ear #K
653-1_296x76/HBA1.J300w1228-2_8474x8081-a/13	150
653-2_296x76/HBA1.J300w1228-2_8474x8081-a/13	200
653-7_296x76/HBA1.J300w1228-2_8474x8081-a/13	200
653-8_296x76/HBA1.J300w1228-2_8474x8081-a/13	200
653-9_296x76/HBA1.J300w1228-2_8474x8081-a/13	300

The first plant in a row of 1228-2 was crossed to NC368, NC474, NC476 and PHP38 then planted ear-to-row and evaluated for resistance to pollination by *gal* in summer nursery 2014. Results are presented in Table 44.

Table 44. Results of *gal* nursery evaluation of 1228-2(8081-a) F_{2:1} crosses from Jalisco 300

Description	Top Ear #K
656-1_368x476.HBA1/J300_1228-2_8579x8081-a/13	17
656-2_368x476.HBA1/J300_1228-2_8579x8081-a/13	500
656-3_368x476.HBA1/J300_1228-2_8579x8081-a/13	500
656-4_368x476.HBA1/J300_1228-2_8579x8081-a/13	500
656-5_368x476.HBA1/J300_1228-2_8579x8081-a/13	500
656-6_368x476.HBA1/J300_1228-2_8579x8081-a/13	350
656-7_368x476.HBA1/J300_1228-2_8579x8081-a/13	400
656-8_368x476.HBA1/J300_1228-2_8579x8081-a/13	400
656-9_368x476.HBA1/J300_1228-2_8579x8081-a/13	xxx
660-1_474x76.HBA1.J300_1228-2_8447x8081-a/13	250
660-2_474x76.HBA1.J300_1228-2_8447x8081-a/13	300
660-3_474x76.HBA1.J300_1228-2_8447x8081-a/13	0
660-4_474x76.HBA1.J300_1228-2_8447x8081-a/13	300
660-5_474x76.HBA1.J300_1228-2_8447x8081-a/13	350
660-6_474x76.HBA1.J300_1228-2_8447x8081-a/13	350
660-7_474x76.HBA1.J300_1228-2_8447x8081-a/13	150
660-8_474x76.HBA1.J300_1228-2_8447x8081-a/13	500
660-9_474x76.HBA1.J300_1228-2_8447x8081-a/13	200
661-1_476x76.HBA1/J300_1228-2_8499x8081-a/13	3
661-2_476x76.HBA1/J300_1228-2_8499x8081-a/13	50
661-3_476x76.HBA1/J300_1228-2_8499x8081-a/13	9
661-4_476x76.HBA1/J300_1228-2_8499x8081-a/13	13
661-5_476x76.HBA1/J300_1228-2_8499x8081-a/13	200
661-6_476x76.HBA1/J300_1228-2_8499x8081-a/13	0
661-7_476x76.HBA1/J300_1228-2_8499x8081-a/13	0
661-8_476x76.HBA1/J300_1228-2_8499x8081-a/13	10

Table 44. Continued

Description	Top Ear #K
661-9_476x76.HBA1/J300_1228-2_8499x8081-a/13	50
665-1_P38x76.HBA1.J300_1228-2_8487x8081-a/13	600
665-2_P38x76.HBA1.J300_1228-2_8487x8081-a/13	0
665-3_P38x76.HBA1.J300_1228-2_8487x8081-a/13	600
665-4_P38x76.HBA1.J300_1228-2_8487x8081-a/13	600
665-5_P38x76.HBA1.J300_1228-2_8487x8081-a/13	14

The second plant in a row of 1228-2 was crossed to both NC368 and NC476, planted ear-to-row, and evaluated for resistance to pollination by *gal* during summer nursery 2014 Results are presented in Table 45.

Table 45. Results of *gal* nursery evaluation of 1228-2(8081-b) F_{2:1} crosses from Jalisco 300

Description	Top Ear #K
657-1_368x76.HBA1/J300_1228-2_8579x8081-b/13	100
657-2_368x76.HBA1/J300_1228-2_8579x8081-b/13	500
657-3_368x76.HBA1/J300_1228-2_8579x8081-b/13	100
657-4_368x76.HBA1/J300_1228-2_8579x8081-b/13	400
657-5_368x76.HBA1/J300_1228-2_8579x8081-b/13	500
657-6_368x76.HBA1/J300_1228-2_8579x8081-b/13	75
664-1_476x76.HBA1/J300_1228-2_8499x8081-b/13	500
664-2_476x76.HBA1/J300_1228-2_8499x8081-b/13	250
664-3_476x76.HBA1/J300_1228-2_8499x8081-b/13	200
664-4_476x76.HBA1/J300_1228-2_8499x8081-b/13	200
664-5_476x76.HBA1/J300_1228-2_8499x8081-b/13	500
664-6_476x76.HBA1/J300_1228-2_8499x8081-b/13	500
664-7_476x76.HBA1/J300_1228-2_8499x8081-b/13	500
664-8_476x76.HBA1/J300_1228-2_8499x8081-b/13	500
664-9_476x76.HBA1/J300_1228-2_8499x8081-b/13	500

Jalisco 304

F₁s/F₂s

1162

1162, a row of (CS405xB47)xJalisco 304 was crossed as numbered plants to ICI986 during summer 2012. Seed from the cross with the ninth numbered plant was planted ear-to-row, crossed to NC368 and evaluated for resistance to pollination by *gal* during winter nursery 2012. Results are presented in Table 46.

Table 46. Results of *gal* nursery evaluation of 1162-9 F₁ crosses from Jalisco 304

Description	Top Ear #K
8560x59-1_368xICI986.CS405/47/J304F1_1450x1162-9/12	0
8560x59-2_368xICI986.CS405/47/J304F1_1450x1162-9/12	500
8560x59-3_368xICI986.CS405/47/J304F1_1450x1162-9/12	0
8560x59-4_368xICI986.CS405/47/J304F1_1450x1162-9/12	150

The self of 1162-9 was planted ear-to-row in isolation during summer 2013 and evaluated for resistance to *gal* pollination. One row of F₂ seed was evaluated, which set one kernel out of eight ears observed. Results are presented in Table 47.

Table 47. Results of *gal* isolation block evaluation of an 1162-9 F₂ line from Jalisco 304

Description	#K on Row	# Ears Obs.	Seg?
6609_CS405xPHB47.J304_1_____1162-09/12	1	8	n

1163

1163, a row of (NK792x(NC354xB47)x Jalisco 304, was crossed as numbered plants to LH206. Seed from the cross with the second numbered plant was planted ear-to-row in winter nursery 2012, and evaluated for resistance to pollination by *gal*. Results are presented in Appendix I Table 9.

1170

1170, a row of (NC320xNC368)xJalisco 304 was crossed to LH206. Seed from this cross was planted ear-to-row and evaluated for resistance to pollination by *gal* in winter nursery 2012. Results are presented in Appendix I Table 10.

BC₁s

1238

1238, a row of (NC476xHBA1)xJalisco 304, was crossed as numbered plants to NC446. Seed from the cross with the twelfth numbered plant was planted ear-to-row in winter nursery 2012, and evaluated for resistance to pollination by *gal*. Results are presented in

Appendix I Table 11. 1238-12 was also crossed to NC258 and evaluated for resistance to pollination by *gal*. Results are presented in Appendix I Table 12.

BC₂s

1162

1162-9, was crossed to NC368 once, and then backcrossed twice to produce BC₂s, which were evaluated for resistance to pollination by *gal* during summer 2014. A second row of the same material, although from a different individual plant (8477-3), was simultaneously evaluated. Results are presented in Table 48.

Table 48. Results of *gal* nursery evaluation of 1162-9 BC₂ crosses from Jalisco 304

Description	Top Ear #K
636-1_68*3x986.405/47/J304_0_62-9_8475x76-5/13	xxx
636-2_68*3x986.405/47/J304_0_62-9_8475x76-5/13	0
636-3_68*3x986.405/47/J304_0_62-9_8475x76-5/13	200
636-4_68*3x986.405/47/J304_0_62-9_8475x76-5/13	250
636-5_68*3x986.405/47/J304_0_62-9_8475x76-5/13	3
636-6_68*3x986.405/47/J304_0_62-9_8475x76-5/13	50
636-7_68*3x986.405/47/J304_0_62-9_8475x76-5/13	300
636-8_68*3x986.405/47/J304_0_62-9_8475x76-5/13	4
636-9_68*3x986.405/47/J304_0_62-9_8475x76-5/13	300
637-1_68*3x986.405/47/J34_12_62-9_8478x77-3/13	0
637-2_68*3x986.405/47/J34_12_62-9_8478x77-3/13	0
637-2_68*3x986.405/47/J34_12_62-9_8478x77-3/13	0
637-3_68*3x986.405/47/J34_12_62-9_8478x77-3/13	25
637-4_68*3x986.405/47/J34_12_62-9_8478x77-3/13	100
637-5_68*3x986.405/47/J34_12_62-9_8478x77-3/13	300
637-6_68*3x986.405/47/J34_12_62-9_8478x77-3/13	0

Table 48. Continued

Description	Top Ear #K
637-7_68*3x986.405/47/J34_12_62-9_8478x77-3/13	1
637-8_68*3x986.405/47/J34_12_62-9_8478x77-3/13	0
637-9_68*3x986.405/47/J34_12_62-9_8478x77-3/13	250

Zacatecas 40**F₁s****9537 and 9538**

9537 and 9538, rows of Zacatecas 40 from the same source, were crossed as numbered plants to LH132 and PHT60 based on synchronous flowering. This seed was planted ear-to-row in an isolation block in summer 2013 to be evaluated for resistance to *gal* pollination. Nine rows were considered to contain resistance. Results are presented in Table 49.

Table 49. Results of *gal* isolation block evaluation of 9537 and 9538 F₁ crosses from Zacatecas 40

Description	#K	# Ears For Type	Seg?
6105_LH132xMaizDul-ZAC40_____9501x9537-02/12	0	6	g
6106_LH132xMaizDul-ZAC40_____9501x9537-03/12	0	6	g
6107_PHT60xMaizDul-ZAC40_____9554x9537-04/12	0	1	?
6108_LH132xMaizDul-ZAC40_____9501x9537-05/12	1	8	g
6109_LH132xMaizDul-ZAC40_____9501x9538-03/12	0	7	g
6110_LH132xMaizDul-ZAC40_____9501x9538-04/12	5	8	g
6111_LH132xMaizDul-ZAC40_____9501x9538-05/12	0	8	g

Table 49. Continued

Description	#K	# Ears For Type	Seg?
6112_LH132xMaizDul-ZAC40_9501x9538-06/12	0	8	g
6113_LH132xMaizDul-ZAC40_9501x9538-08/12	0	8	g
6114_LH132xMaizDul-ZAC40_9501x9538-09/12	28	8	g

The source of isolation rows 6105 and 6106 in Table 49, 9537-2 and 9537-3 respectively, were also evaluated as individual plants in a 2013 summer nursery row. 9537-5 and 9538-3, the sources of isolation rows 6108 and 6109, were also crossed to NC368 and evaluated as individual plants in a nursery row. The cross with 9538-4, the source of isolation row 6110, was also planted ear-to-row and reevaluated in the 2014 summer nursery. Results are presented in Table 50.

Table 50. Results of *gal* nursery evaluation of 9537 F₁ crosses from Zacatecas 40

Description	Top Ear #K
132x9537-02_0_ZAC40_LH132x9537-02/12	8
132x9537-02_0_ZAC40_LH132x9537-02/12	1
132x9537-02_0_ZAC40_LH132x9537-02/12	0
132x9537-02_0_ZAC40_LH132x9537-02/12	0
132x9537-02_0_ZAC40_LH132x9537-02/12	10
132x9537-02_0_ZAC40_LH132x9537-02/12	0
132x9537-02_0_ZAC40_LH132x9537-02/12	1
132x9537-02_0_ZAC40_LH132x9537-02/12	5
132x9537-03_3_ZAC40_LH132x9537-03/12	xxx
132x9537-03_3_ZAC40_LH132x9537-03/12	15
132x9537-03_3_ZAC40_LH132x9537-03/12	0

Table 50. Continued

Description	Top Ear #K
132x9537-03_3_ZAC40_LH132x9537-03/12	0
132x9537-03_3_ZAC40_LH132x9537-03/12	15
132x9537-03_3_ZAC40_LH132x9537-03/12	0
132x9537-03_3_ZAC40_LH132x9537-03/12	0
368x9537-05_0_ZAC40_NC368x9537-05/12	1
368x9537-05_0_ZAC40_NC368x9537-05/12	10
368x9537-05_0_ZAC40_NC368x9537-05/12	10
368x9537-05_0_ZAC40_NC368x9537-05/12	0
368x9537-05_0_ZAC40_NC368x9537-05/12	25
368x9537-05_0_ZAC40_NC368x9537-05/12	3
368x9537-05_0_ZAC40_NC368x9537-05/12	xxx
368x9537-05_0_ZAC40_NC368x9537-05/12	10
368x9537-05_0_ZAC40_NC368x9537-05/12	0
368x9538-03_6_ZAC40_NC368x9538-03/12	1
368x9538-03_6_ZAC40_NC368x9538-03/12	25
368x9538-03_6_ZAC40_NC368x9538-03/12	15
368x9538-03_6_ZAC40_NC368x9538-03/12	0
368x9538-03_6_ZAC40_NC368x9538-03/12	8
368x9538-03_6_ZAC40_NC368x9538-03/12	200
368x9538-03_6_ZAC40_NC368x9538-03/12	8
368x9538-03_6_ZAC40_NC368x9538-03/12	4
368x9538-03_6_ZAC40_NC368x9538-03/12	0
1538-1_LH132xMaizDul-ZAC40_9501x9538-04/12	0
1538-2_LH132xMaizDul-ZAC40_9501x9538-04/12	0
1538-3_LH132xMaizDul-ZAC40_9501x9538-04/12	0
1538-4_LH132xMaizDul-ZAC40_9501x9538-04/12	0
1538-5_LH132xMaizDul-ZAC40_9501x9538-04/12	0
1538-6_LH132xMaizDul-ZAC40_9501x9538-04/12	0
1538-7_LH132xMaizDul-ZAC40_9501x9538-04/12	0
1538-8_LH132xMaizDul-ZAC40_9501x9538-04/12	0
1538-9_LH132xMaizDul-ZAC40_9501x9538-04/12	xxx

The source of isolation row 6111(Table 49), 9538-5, was also evaluated as individual plants in a 2013 summer nursery row. 9538-6, 9538-8, and 9538-9 the sources of isolation rows 6112, 6113, and 6114 respectively, were crossed to NC368 and evaluated as individual plants in a nursery row. Results are presented in Table 51.

Table 51. Results of *gal* nursery evaluation of 9538 F₁ crosses from Zacatecas 40

Description	R13 Row	Top Ear #K
132x9538-05_ZAC40_LH132x9538-05/12	192-01	1
132x9538-05_ZAC40_LH132x9538-05/12	192-02	3
132x9538-05_ZAC40_LH132x9538-05/12	192-03	0
132x9538-05_ZAC40_LH132x9538-05/12	192-04	1
132x9538-05_ZAC40_LH132x9538-05/12	192-05	0
132x9538-05_ZAC40_LH132x9538-05/12	192-06	0
132x9538-05_ZAC40_LH132x9538-05/12	192-07	8
132x9538-05_ZAC40_LH132x9538-05/12	192-08	5
132x9538-05_ZAC40_LH132x9538-05/12	192-09	0
368x9538-06_ZAC40_NC368x9538-06/12	244-01	1
368x9538-06_ZAC40_NC368x9538-06/12	244-02	0
368x9538-06_ZAC40_NC368x9538-06/12	244-03	1
368x9538-06_ZAC40_NC368x9538-06/12	244-04	0
368x9538-06_ZAC40_NC368x9538-06/12	244-05	0
368x9538-06_ZAC40_NC368x9538-06/12	244-06	1
368x9538-06_ZAC40_NC368x9538-06/12	244-07	10
368x9538-06_ZAC40_NC368x9538-06/12	244-08	100
368x9538-06_ZAC40_NC368x9538-06/12	244-09	0
368x9538-08_ZAC40_NC368x9538-08/12	245-01	10
368x9538-08_ZAC40_NC368x9538-08/12	245-02	50
368x9538-08_ZAC40_NC368x9538-08/12	245-03	7
368x9538-08_ZAC40_NC368x9538-08/12	245-04	100
368x9538-08_ZAC40_NC368x9538-08/12	245-05	100
368x9538-08_ZAC40_NC368x9538-08/12	245-06	1
368x9538-08_ZAC40_NC368x9538-08/12	245-07	2

Table 51. Continued

Description	R13 Row	Top Ear #K
368x9538-08_ZAC40_NC368x9538-08/12	245-08	xxx
368x9538-08_ZAC40_NC368x9538-08/12	245-09	12
368x9538-09_ZAC40_NC368x9538-09/12	248-01	1
368x9538-09_ZAC40_NC368x9538-09/12	248-02	0
368x9538-09_ZAC40_NC368x9538-09/12	248-03	xxx
368x9538-09_ZAC40_NC368x9538-09/12	248-04	5
368x9538-09_ZAC40_NC368x9538-09/12	248-05	0
368x9538-09_ZAC40_NC368x9538-09/12	248-06	0
368x9538-09_ZAC40_NC368x9538-09/12	248-07	15
368x9538-09_ZAC40_NC368x9538-09/12	248-08	5
368x9538-09_ZAC40_NC368x9538-09/12	248-09	15

9537-1, a source not evaluated in isolation rows, was crossed to (NK792xNC474) and evaluated as individual plants in a 2013 summer nursery row. 9538-9, the source of isolation row 6114 (Table 49), was also crossed to (NK792xNC474) and evaluated as individual plants in a nursery row. Results are presented in Table 52.

Table 52. Results of *gal* nursery evaluation of 9537 F₁ crosses from Zacatecas 40

Description	R13 Row	Top Ear #K
792.474x9537-1_0Z40_792.474x9537-1/12	264-01	0
792.474x9537-1_0Z40_792.474x9537-1/12	264-02	12
792.474x9537-1_0Z40_792.474x9537-1/12	264-03	0
792.474x9537-1_0Z40_792.474x9537-1/12	264-04	200
792.474x9537-1_0Z40_792.474x9537-1/12	264-05	400
792.474x9537-1_0Z40_792.474x9537-1/12	264-06	0
792.474x9537-1_0Z40_792.474x9537-1/12	264-07	200

Table 52. Continued

Description	R13 Row	Top Ear #K
792.474x9537-1_0Z40_792.474x9537-1/12	264-08	30
792.474x9537-1_0Z40_792.474x9537-1/12	264-09	2
792.474x9537-4_0Z40_792.474x9537-4/12	265-01	1
792.474x9537-4_0Z40_792.474x9537-4/12	265-02	350
792.474x9537-4_0Z40_792.474x9537-4/12	265-03	500
792.474x9537-4_0Z40_792.474x9537-4/12	265-04	15
792.474x9537-4_0Z40_792.474x9537-4/12	265-05	1
792.474x9537-4_0Z40_792.474x9537-4/12	265-06	3
792.474x9537-4_0Z40_792.474x9537-4/12	265-07	xxx
792.474x9537-4_0Z40_792.474x9537-4/12	265-08	3
792.474x9537-4_0Z40_792.474x9537-4/12	265-09	xxx

F_{2:1}S/ BC₁S

The material from isolation rows 6111 and 6112 (LH132xZacatecas 40), 9538-5 and 9538-6 (Table 49), were crossed to NC368 as numbered plants. Resulting seed was planted ear-to-row in summer nursery 2014 and individual plants were evaluated for resistance to *gal* pollination. Results are presented in Table 53.

Table 53. Results of *gal* nursery evaluation of 9538-5 and 9538-6 F_{2:1} crosses from Zacatecas 40

Description	Top Ear #K
1537-1_368x132.9538-5S1_000_ZAC40_101x192-03/13	999
1537-2_368x132.9538-5S1_000_ZAC40_101x192-03/13	0
1537-3_368x132.9538-5S1_000_ZAC40_101x192-03/13	999
1537-4_368x132.9538-5S1_000_ZAC40_101x192-03/13	0
1537-5_368x132.9538-5S1_000_ZAC40_101x192-03/13	0

Table 53. Continued

Description	Top Ear #K
1537-6_368x132.9538-5S1_000_ZAC40_101x192-03/13	999
1537-7_368x132.9538-5S1_000_ZAC40_101x192-03/13	0
1537-8_368x132.9538-5S1_000_ZAC40_101x192-03/13	0
1537-9_368x132.9538-5S1_000_ZAC40_101x192-03/13	999
1536-1_368*2x9538-6_000_ZAC40BCS1_101x244-05/13	5
1536-2_368*2x9538-6_000_ZAC40BCS1_101x244-05/13	999
1536-3_368*2x9538-6_000_ZAC40BCS1_101x244-05/13	0
1536-4_368*2x9538-6_000_ZAC40BCS1_101x244-05/13	999
1536-7_368*2x9538-6_000_ZAC40BCS1_101x244-05/13	999
1536-8_368*2x9538-6_000_ZAC40BCS1_101x244-05/13	999
1536-9_368*2x9538-6_000_ZAC40BCS1_101x244-05/13	999

The same plant that produced isolation row 6113 above (Table 49), was also crossed to NC368, and then crossed once to PHB47. The cross with the sixth plant in the F₁ row was planted ear-to-row in the 2014 summer nursery and evaluated for resistance to pollination by *gal*. Results are presented in Table 54.

Table 54. Results of *gal* nursery evaluation of 9538-8(245-6) F_{2:1} crosses from Zacatecas 40

Description	Top Ear #K
1535-1_B47x368.9538-08S1_001_Z40_2401x245-06/13	xxx
1535-2_B47x368.9538-08S1_001_Z40_2401x245-06/13	0
1535-3_B47x368.9538-08S1_001_Z40_2401x245-06/13	999
1535-4_B47x368.9538-08S1_001_Z40_2401x245-06/13	0
1535-5_B47x368.9538-08S1_001_Z40_2401x245-06/13	0
1535-6_B47x368.9538-08S1_001_Z40_2401x245-06/13	999
1535-7_B47x368.9538-08S1_001_Z40_2401x245-06/13	999
1535-8_B47x368.9538-08S1_001_Z40_2401x245-06/13	999

Table 54. Continued

Description	Top Ear #K
1535-9_B47x368.9538-08S1_001_Z40_2401x245-06/13	999

The same plant that produced isolation row 6107 (Table 49), was crossed to NK792xNC474, and then crossed once to NC368. The cross with the first plant in the F₁ row was planted ear-to-row in the 2014 summer nursery and evaluated for resistance to pollination by *gal*.

Results are presented in Table 55.

Table 55. Results of *gal* nursery evaluation of 9537-1(264-1) F_{2:1} crosses from Zacatecas 40

Description	Top Ear #K
1544-1_368x792/474.9537-1S1_0_Z40_101x264-01/13	0
1544-2_368x792/474.9537-1S1_0_Z40_101x264-01/13	0
1544-3_368x792/474.9537-1S1_0_Z40_101x264-01/13	xxx
1544-4_368x792/474.9537-1S1_0_Z40_101x264-01/13	0
1544-5_368x792/474.9537-1S1_0_Z40_101x264-01/13	0
1544-6_368x792/474.9537-1S1_0_Z40_101x264-01/13	0
1544-7_368x792/474.9537-1S1_0_Z40_101x264-01/13	0
1544-8_368x792/474.9537-1S1_0_Z40_101x264-01/13	999
1544-9_368x792/474.9537-1S1_0_Z40_101x264-01/13	0

9537-4, the same source as R13 row 264 (Table 52) and related to isolation rows 6105-6108, was crossed to NK792xNC474, and then crossed once to NC368. The cross with the first plant in the F₁ row was planted ear-to-row in the 2014 summer nursery and evaluated for resistance to pollination by *gal*. Results are presented in Appendix I Table 13.

BC₂s/Pseudo-BC₂s

9538-3, the same source as isolation row 6109 (Table 49), was backcrossed twice to produce BC₂ seed. The cross with the fifth plant in the row was harvested, planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 56.

Table 56. Results of *gal* nursery evaluation of 9538-3(8600-5) BC₂ lines from Zacatecas 40

Description	Top Ear #K
1539-1_368*3x9538-3BC2S1_002_ZAC40_8599x00-5/13	1
1539-2_368*3x9538-3BC2S1_002_ZAC40_8599x00-5/13	999
1539-3_368*3x9538-3BC2S1_002_ZAC40_8599x00-5/13	2
1539-4_368*3x9538-3BC2S1_002_ZAC40_8599x00-5/13	999
1539-5_368*3x9538-3BC2S1_002_ZAC40_8599x00-5/13	8
1539-6_368*3x9538-3BC2S1_002_ZAC40_8599x00-5/13	5
1539-7_368*3x9538-3BC2S1_002_ZAC40_8599x00-5/13	999
1539-8_368*3x9538-3BC2S1_002_ZAC40_8599x00-5/13	999
1539-9_368*3x9538-3BC2S1_002_ZAC40_8599x00-5/13	1

9538-9, the same source as isolation row 6114 (Table 49), was backcrossed twice to produce BC₂ seed. The cross with second plant in the row was harvested, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 57.

Table 57. Results of *gal* nursery evaluation of 9538-9(8601-2) BC₂ lines from Zacatecas 40

Description	Top Ear #K
669-1_368*3x9538-9__003_ZAC40_8602x01-2/13	25
669-2_368*3x9538-9__003_ZAC40_8602x01-2/13	0
669-3_368*3x9538-9__003_ZAC40_8602x01-2/13	350
669-4_368*3x9538-9__003_ZAC40_8602x01-2/13	350
669-5_368*3x9538-9__003_ZAC40_8602x01-2/13	300
669-6_368*3x9538-9__003_ZAC40_8602x01-2/13	32
669-7_368*3x9538-9__003_ZAC40_8602x01-2/13	17
669-8_368*3x9538-9__003_ZAC40_8602x01-2/13	300
669-9_368*3x9538-9__003_ZAC40_8602x01-2/13	xxx

Sampling from the third plant in the row of the BC₁ generation provided additional material for screening. Individual plants evaluated for resistance to *gal* pollination during summer 2014. Results are presented in Appendix I Table 14. 9537-2, the same source as isolation row 6105 (Table 49), was crossed twice to NC368. The cross with the second plant in the row was harvested, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 58.

Table 58. Results of *gal* nursery evaluation of 9537-2(8576-2) pseudo-BC₂ lines from Zacatecas 40

Description	Top Ear #K
1543-1_368*2x132.9537-2_Z40BCS1_8575x76-2/13	999
1543-2_368*2x132.9537-2_Z40BCS1_8575x76-2/13	1
1543-3_368*2x132.9537-2_Z40BCS1_8575x76-2/13	999
1543-4_368*2x132.9537-2_Z40BCS1_8575x76-2/13	10
1543-5_368*2x132.9537-2_Z40BCS1_8575x76-2/13	55
1543-6_368*2x132.9537-2_Z40BCS1_8575x76-2/13	100

Table 58. Continued

Description	Top Ear #K
1543-7_368*2x132.9537-2_Z40BCS1_8575x76-2/13	xxx
1543-8_368*2x132.9537-2_Z40BCS1_8575x76-2/13	0
1543-9_368*2x132.9537-2_Z40BCS1_8575x76-2/13	17

9537-3 and 9537-5, the same source as isolation rows 6106 and 6108 (Table 49), were crossed as male to PHB47, then to NC368. The cross with the third plant in the row was harvested, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 59.

Table 59. Results of *gal* nursery evaluation of 9537-3 and 9537-5 pseudo-BC₂ lines from Zacatecas 40

Description	Top Ear #K
1542-1_368xB47.132/9537-3S1_000Z40_8603x04-3/13	999
1542-2_368xB47.132/9537-3S1_000Z40_8603x04-3/13	5
1542-3_368xB47.132/9537-3S1_000Z40_8603x04-3/13	999
1542-4_368xB47.132/9537-3S1_000Z40_8603x04-3/13	999
1542-5_368xB47.132/9537-3S1_000Z40_8603x04-3/13	0
1542-6_368xB47.132/9537-3S1_000Z40_8603x04-3/13	999
1542-7_368xB47.132/9537-3S1_000Z40_8603x04-3/13	999
1542-8_368xB47.132/9537-3S1_000Z40_8603x04-3/13	0
1542-9_368xB47.132/9537-3S1_000Z40_8603x04-3/13	0
1540-1_368xB47.368/9537-5S1_000Z40_8607x08-3/13	0
1540-2_368xB47.368/9537-5S1_000Z40_8607x08-3/13	999
1540-3_368xB47.368/9537-5S1_000Z40_8607x08-3/13	0
1540-4_368xB47.368/9537-5S1_000Z40_8607x08-3/13	999
1540-5_368xB47.368/9537-5S1_000Z40_8607x08-3/13	999
1540-6_368xB47.368/9537-5S1_000Z40_8607x08-3/13	999

Table 59. Continued

Description	Top Ear #K
1540-7_368xB47.368/9537-5S1_000Z40_8607x08-3/13	xxx
1540-8_368xB47.368/9537-5S1_000Z40_8607x08-3/13	999
1540-9_368xB47.368/9537-5S1_000Z40_8607x08-3/13	999

Zacatecas 182

F₁s/F₂s

1349

1349, a row of Zacatecas 182, was crossed as numbered plants to various lines, and then planted ear-to-row and evaluated for resistance to pollination by *gal* in winter nursery 2012.. The second such plant was crossed to NC476, planted ear-to-row, and evaluated. Results are presented in Appendix I Table 15. 1349-3, the third plant in the original row, was crossed to NC476, planted ear-to-row, and evaluated. Results are presented in Appendix I Table 16. 1349-4, the fourth plant in the original row, was crossed to HBA1, planted ear-to-row, and evaluated. Results are presented in Appendix I Table 17. 1349-5, the fifth plant in the original row, was crossed to both HBA1 and NC476. Resulting seed was planted ear-to-row in winter nursery 2012, and evaluated. Results are presented in Table 60.

Table 60. Results of *gal* nursery evaluation of 1349-5 BC₁ lines in two backgrounds from Zacatecas 182

Description	Top Ear #K
8581x82-1_HBA1*2xZac182_BC1_____1292x1349-5/12	450
8581x82-2_HBA1*2xZac182_BC1_____1292x1349-5/12	500
8581x82-3_HBA1*2xZac182_BC1_____1292x1349-5/12	120
8581x82-4_HBA1*2xZac182_BC1_____1292x1349-5/12	450
8584x83-1_NC476*2xZac182_BC1_____1216x1349-5/12	80
8584x83-2_NC476*2xZac182_BC1_____1216x1349-5/12	20
8584x83-3_NC476*2xZac182_BC1_____1216x1349-5/12	1
8584x83-4_NC476*2xZac182_BC1_____1216x1349-5/12	0

1349-9, the ninth plant in the original row, was crossed to LH181, planted ear-to-row in summer nursery 2013, and evaluated. Of the six ears evaluated, one set a single kernel, two set twenty-five or fewer kernels, and three set more than fifty kernels on each ear. Results are presented in Table 61.

Table 61. Results of *gal* nursery evaluation of 1349-9 F₁ lines from Zacatecas 182

Description	R13 Row	Top Ear #K
LH181xZac182_____1453x1349-9/12	1988-01	25
LH181xZac182_____1453x1349-9/12	1988-02	xxx
LH181xZac182_____1453x1349-9/12	1988-03	14
LH181xZac182_____1453x1349-9/12	1988-04	>50
LH181xZac182_____1453x1349-9/12	1988-05	>50
LH181xZac182_____1453x1349-9/12	1988-06a	xxx
LH181xZac182_____1453x1349-9/12	1988-06b	xxx
LH181xZac182_____1453x1349-9/12	1988-07	1
LH181xZac182_____1453x1349-9/12	1988-09	>50

1411

1411, a row of Zacatecas 182, was crossed as numbered plants to various lines, and then planted ear-to-row and evaluated for resistance to pollination by *gal* in summer nursery 2013. 1411-3, the third plant in the original row, was crossed to LH165, planted ear-to-row, and evaluated. Results are presented in Table 62.

Table 62. Results of *gal* nursery evaluation of 1411-3 F₁ lines from Zacatecas 182

Description	R13 Row	Top Ear #K
LH165xZac182 1452x1411-3/12	1989-01	0
LH165xZac182 1452x1411-3/12	1989-02	25
LH165xZac182 1452x1411-3/12	1989-03	2
LH165xZac182 1452x1411-3/12	1989-04	>50
LH165xZac182 1452x1411-3/12	1989-05	13
LH165xZac182 1452x1411-3/12	1989-06	xxx
LH165xZac182 1452x1411-3/12	1989-07	25
LH165xZac182 1452x1411-3/12	1989-08	>50
LH165xZac182 1452x1411-3/12	1989-09	2

1411-4, the fourth plant in the original row, was crossed to both NC296, a line known to contain *Gal-s*, and P37x4639-1. Resulting seed was planted ear-to-row, and evaluated in winter nursery 2012. Results are presented in Appendix I Table 18. 1411-5, the fifth plant in the original row, was crossed to NC476, planted ear-to-row, and evaluated. Results are presented in Appendix I Table 19. 1411-6 and 1411-9 were crossed to ICI581, planted ear-to-row, and evaluated. Results are presented in Table 63.

Table 63. Results of *gal* nursery evaluation of 1411 derived F₁ lines from Zacatecas 182

Description	R13 Row	Top Ear #K
ICI581xZac182_ 1448x1411-6/12	1993-01	0
ICI581xZac182_ 1448x1411-6/12	1993-02	xxx
ICI581xZac182_ 1448x1411-6/12	1993-03	0
ICI581xZac182_ 1448x1411-6/12	1993-04	0
ICI581xZac182_ 1448x1411-6/12	1993-05	1
ICI581xZac182_ 1448x1411-6/12	1993-06	0
ICI581xZac182_ 1448x1411-6/12	1993-07	0
ICI581xZac182_ 1448x1411-6/12	1993-08	0
ICI581xZac182_ 1448x1411-6/12	1993-09	0
ICI581xZac182_ 1448x1411-9a/12	1996-01	0
ICI581xZac182_ 1448x1411-9a/12	1996-02	0
ICI581xZac182_ 1448x1411-9a/12	1996-03	0
ICI581xZac182_ 1448x1411-9a/12	1996-04	0
ICI581xZac182_ 1448x1411-9a/12	1996-05	0
ICI581xZac182_ 1448x1411-9a/12	1996-06	1
ICI581xZac182_ 1448x1411-9a/12	1996-07	0
ICI581xZac182_ 1448x1411-9a/12	1996-08	0
ICI581xZac182_ 1448x1411-9a/12	1996-09	0

1411-11, the eleventh plant in the original row, was crossed to NC476 and LH216, planted ear-to-row, and evaluated. Crosses to NC476 were evaluated during winter nursery 2012, and those to LH216 were evaluated during summer 2013. Results are presented in Table 64.

Table 64. Results of *gal* nursery evaluation of 1411-11 BC₁ lines from Zacatecas 182

Description	Top Ear #K
NC476*2xZac182_ BC1_ 1232x1411-11/12	9
NC476*2xZac182_ BC1_ 1232x1411-11/12	1

Table 64. Continued

Description	Top Ear #K
NC476*2xZac182__BC1_____1232x1411-11/12	0
NC476*2xZac182__BC1_____1232x1411-11/12	6
LH216xZac182__1461x1411-11/12	0
LH216xZac182__1461x1411-11/12	0
LH216xZac182__1461x1411-11/12	0
LH216xZac182__1461x1411-11/12	0
LH216xZac182__1461x1411-11/12	0
LH216xZac182__1461x1411-11/12	0

1411-13, the thirteenth plant in the original row, was crossed to PHN46, planted ear-to-row, and evaluated during winter nursery 2012. Results are presented in Table 65.

Table 65. Results of *gal* nursery evaluation of 1411-13 BC₁ lines from Zacatecas 182

Description	Top Ear #K
8597x98-1_PHN46*2xZac182__BC1_____1376x1411-13/12	20
8597x98-2_PHN46*2xZac182__BC1_____1376x1411-13/12	4
8597x98-3_PHN46*2xZac182__BC1_____1376x1411-13/12	30
8597x98-4_PHN46*2xZac182__BC1_____1376x1411-13/12	150

1411-14, the fourteenth plant in the original row, was crossed to PHN46, planted ear-to-row, and evaluated during summer nursery 2013. Results are presented in Table 66.

Table 66. Results of *gal* nursery evaluation of 1411-14 F₁ lines from Zacatecas 182

Description	R13 Row	Top Ear #K
PHV57xZac182_1470x1411-14/12	2000-04	0
PHV57xZac182_1470x1411-14/12	2000-07	0

(1470x1411-14), the source of R13 row 2000-4 (Table 66) was crossed to DKBHA1, planted ear-to-row and evaluated for resistance to *gal* pollination during summer nursery 2014.

Results are presented in Table 67.

Table 67. Results of additional *gal* nursery evaluation of 1411-14 F₁ lines from Zacatecas 182

Description	Top Ear #K
1562-1_HBAxPV57.Z182S1_01411-14r_1987x2000-4/13	999
1562-2_HBAxPV57.Z182S1_01411-14r_1987x2000-4/13	1
1562-3_HBAxPV57.Z182S1_01411-14r_1987x2000-4/13	999
1562-4_HBAxPV57.Z182S1_01411-14r_1987x2000-4/13	999
1562-5_HBAxPV57.Z182S1_01411-14r_1987x2000-4/13	xxx
1562-6_HBAxPV57.Z182S1_01411-14r_1987x2000-4/13	999
1562-7_HBAxPV57.Z182S1_01411-14r_1987x2000-4/13	999
1562-8_HBAxPV57.Z182S1_01411-14r_1987x2000-4/13	999
1562-9_HBAxPV57.Z182S1_01411-14r_1987x2000-4/13	999

9539 and 9540

9539 and 9540, two rows of Zacatecas 182, were crossed as numbered plants to various inbred lines. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in an isolation block during summer 2013. Results are presented in Table 68.

Table 68. Results of *gal* isolation block evaluation of 9539 and 9540 F₁ lines from Zacatecas 182

Description	#K	# Ears For Type	Seg?
6115_NC368xMaizDul-ZAC182____9516x9539-02/12	999	8	n
6116_LH132xMaizDul-ZAC182____9501x9539-03/12	16	8	g
6117_LH132xMaizDul-ZAC182____9501x9539-04/12	0	4	s
6118_LH132xMaizDul-ZAC182____9501x9539-05/12	0	3	s
6119_LH132xMaizDul-ZAC182____9501x9539-06/12	45	8	?
6120_LH132xMaizDul-ZAC182____9501x9539-07/12	15	3	?
6121_LH132xMaizDul-ZAC182____9501x9539-09/12	25	5	?
6122_LH132xMaizDul-ZAC182____9501x9539-10/12	35	3	?
6123_PHT60xMaizDul-ZAC182____9554x9539-11/12	1	3	s
6124_LH132xMaizDul-ZAC182____9501x9540-02/12	7	2	?
6125_LH132xMaizDul-ZAC182____9501x9540-03/12	0	3	?
6126_LH132xMaizDul-ZAC182____9501x9540-10/12	0	3	s
6127_LH132xMaizDul-ZAC182____9501x9540-13/12	5	2	s

9539

9539-2, 9539-4, 9539-5, 9539-9 and 9539-10 the same sources as isolation rows 6115, 6117, 6118, 6121 and 6122 (Table 68), were crossed as male to NC368, planted ear-to-row and

evaluated for resistance to *gal* pollination during summer 2013. Results are presented in Table 69.

Table 69. Results of *gal* nursery evaluation of NC368x9539 F₁ lines from Zacatecas 182

Description	R13 Row	Top Ear #K
ZAC182_NC368x9539-02/12	249-01	100
ZAC182_NC368x9539-02/12	249-02	300
ZAC182_NC368x9539-02/12	249-03	80
ZAC182_NC368x9539-02/12	249-04	100
ZAC182_NC368x9539-02/12	249-05	2
ZAC182_NC368x9539-02/12	249-06	15
ZAC182_NC368x9539-02/12	249-07	800
ZAC182_NC368x9539-02/12	249-08	800
ZAC182_NC368x9539-02/12	249-09	xxx
ZAC182_NC368x9539-04/12	252-01	0
ZAC182_NC368x9539-04/12	252-02	7
ZAC182_NC368x9539-04/12	252-03	0
ZAC182_NC368x9539-04/12	252-04	15
ZAC182_NC368x9539-04/12	252-05	25
ZAC182_NC368x9539-04/12	252-06	2
ZAC182_NC368x9539-04/12	252-07	0
ZAC182_NC368x9539-04/12	252-08	2
ZAC182_NC368x9539-04/12	252-09	2
ZAC182_NC368x9539-05/12	253-01	75
ZAC182_NC368x9539-05/12	253-02	3
ZAC182_NC368x9539-05/12	253-03	25
ZAC182_NC368x9539-05/12	253-04	4
ZAC182_NC368x9539-05/12	253-05	100
ZAC182_NC368x9539-05/12	253-06	50
ZAC182_NC368x9539-05/12	253-07	75
ZAC182_NC368x9539-05/12	253-08	xxx
ZAC182_NC368x9539-05/12	253-09	50
ZAC182_NC368x9539-09/12	256-01	0
ZAC182_NC368x9539-09/12	256-02	600

Table 69. Continued

Description	R13 Row	Top Ear #K
ZAC182 NC368x9539-09/12	256-03	15
ZAC182 NC368x9539-09/12	256-04	15
ZAC182 NC368x9539-09/12	256-05	600
ZAC182 NC368x9539-09/12	256-06	100
ZAC182 NC368x9539-09/12	256-07	7
ZAC182 NC368x9539-09/12	256-08	xxx
ZAC182 NC368x9539-09/12	256-09	100
ZAC182 NC368x9539-10/12	257-01	40
ZAC182 NC368x9539-10/12	257-02	50
ZAC182 NC368x9539-10/12	257-03	3
ZAC182 NC368x9539-10/12	257-04	3
ZAC182 NC368x9539-10/12	257-05	5
ZAC182 NC368x9539-10/12	257-06	15
ZAC182 NC368x9539-10/12	257-07	6
ZAC182 NC368x9539-10/12	257-08	6
ZAC182 NC368x9539-10/12	257-09	600

9539-3 and 9539-7, the same sources as isolation rows 6116 and 6120 above (Table 68), were crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination during summer 2013. Results are presented in Table 70.

Table 70. Results of *gal* nursery evaluation of 9539-3 and 9539-7 F₁ lines from Zacatecas 182

Description	R13 Row	Top Ear #K
ZAC182 LH132x9539-03/12	193-01	0
ZAC182 LH132x9539-03/12	193-02	15
ZAC182 LH132x9539-03/12	193-03	1

Table 70. Continued

Description	R13 Row	Top Ear #K
ZAC182_LH132x9539-03/12	193-04	3
ZAC182_LH132x9539-03/12	193-05	xxx
ZAC182_LH132x9539-03/12	193-06	0
ZAC182_LH132x9539-03/12	193-07	0
ZAC182_LH132x9539-03/12	193-08	0
ZAC182_LH132x9539-03/12	193-09	0
ZAC182_LH132x9539-07/12	194-01	4
ZAC182_LH132x9539-07/12	194-02	0
ZAC182_LH132x9539-07/12	194-03	10
ZAC182_LH132x9539-07/12	194-04	15
ZAC182_LH132x9539-07/12	194-05	0
ZAC182_LH132x9539-07/12	194-06	>50
ZAC182_LH132x9539-07/12	194-07	>50
ZAC182_LH132x9539-07/12	194-08	0
ZAC182_LH132x9539-07/12	194-09	0

9539-11, the same source as isolation row 6123 above (Table 68), was also crossed to PHT60, planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 71.

Table 71. Results of *gal* nursery evaluation of 9539-11 F₁ lines from Zacatecas 182

Description	Top Ear #K
1570-1_PHT60xMaizDul-ZAC182_S1_9554x9539-11/12	0
1570-2_PHT60xMaizDul-ZAC182_S1_9554x9539-11/12	0
1570-3_PHT60xMaizDul-ZAC182_S1_9554x9539-11/12	50
1570-4_PHT60xMaizDul-ZAC182_S1_9554x9539-11/12	999
1570-5_PHT60xMaizDul-ZAC182_S1_9554x9539-11/12	0
1570-6_PHT60xMaizDul-ZAC182_S1_9554x9539-11/12	8

Table 71. Continued

Description	Top Ear #K
1570-7_PHT60xMaizDul-ZAC182_S1_9554x9539-11/12	0
1570-8_PHT60xMaizDul-ZAC182_S1_9554x9539-11/12	0
1570-9_PHT60xMaizDul-ZAC182_S1_9554x9539-11/12	0

9540

9540-2, 9540-10, and 9540-13, the same sources as isolation rows 6124, 6126 and 6127 above (Table 68), were crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2013 Results are presented in Table 72.

Table 72. Results of *gal* nursery evaluation of LH132x9540 F₁ lines from Zacatecas 182

Description	R13 Row	Top Ear #K
ZAC182_LH132x9540-02/12	195-01	>50
ZAC182_LH132x9540-02/12	195-02	25
ZAC182_LH132x9540-02/12	195-03	>50
ZAC182_LH132x9540-02/12	195-04	6
ZAC182_LH132x9540-02/12	195-05	0
ZAC182_LH132x9540-02/12	195-06	20
ZAC182_LH132x9540-02/12	195-07	xxx
ZAC182_LH132x9540-02/12	195-08	30
ZAC182_LH132x9540-02/12	195-09	>50
ZAC182_LH132x9540-10/12	196-01	5
ZAC182_LH132x9540-10/12	196-02	0
ZAC182_LH132x9540-10/12	196-03	4
ZAC182_LH132x9540-10/12	196-04	1
ZAC182_LH132x9540-10/12	196-05	10

Table 72. Continued

Description	R13 Row	Top Ear #K
ZAC182 LH132x9540-10/12	196-06	15
ZAC182 LH132x9540-10/12	196-07	3
ZAC182 LH132x9540-10/12	196-08	2
ZAC182 LH132x9540-10/12	196-09	5
ZAC182 LH132x9540-13/12	197-01	1
ZAC182 LH132x9540-13/12	197-02	>50
ZAC182 LH132x9540-13/12	197-03	>50
ZAC182 LH132x9540-13/12	197-04	0
ZAC182 LH132x9540-13/12	197-05	10
ZAC182 LH132x9540-13/12	197-06	25

9540-3 and 9540-10, the same sources as isolation row 6125 and 6126 above (Table 68), were crossed as male to NC368, planted ear-to-row and evaluated for resistance to *gal* pollination in the summer 2013 nursery. Results are presented in Table 73.

Table 73. Results of *gal* nursery evaluation of 9540 F₁ lines from Zacatecas 182

Description	R13 Row	Top Ear #K
ZAC182 NC368x9540-03/12	260-01	1
ZAC182 NC368x9540-03/12	260-02	15
ZAC182 NC368x9540-03/12	260-03	0
ZAC182 NC368x9540-03/12	260-04	12
ZAC182 NC368x9540-03/12	260-05	xxx
ZAC182 NC368x9540-03/12	260-06	0
ZAC182 NC368x9540-03/12	260-07	2
ZAC182 NC368x9540-03/12	260-08	xxx
ZAC182 NC368x9540-03/12	260-09	1
ZAC182 LH51x9540-10/12	89-01	7

Table 73. Continued

Description	R13 Row	Top Ear #K
ZAC182_LH51x9540-10/12	89-02	0
ZAC182_LH51x9540-10/12	89-03	0
ZAC182_LH51x9540-10/12	89-04	>50
ZAC182_LH51x9540-10/12	89-05	>50
ZAC182_LH51x9540-10/12	89-06	7
ZAC182_LH51x9540-10/12	89-07	20
ZAC182_LH51x9540-10/12	89-08	1
ZAC182_LH51x9540-10/12	89-09	20

LH51x9540-10 was crossed to HBA1, seed of which was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 74.

Table 74. Results of *gal* nursery evaluation of HBA1x(LH51x9540-10) F₂ lines from Zacatecas 182

Description	Top Ear #K
1573-1_HBA1xLH51.9540-10F2org01Z182_95x89-08/13	999
1573-2_HBA1xLH51.9540-10F2org01Z182_95x89-08/13	100
1573-3_HBA1xLH51.9540-10F2org01Z182_95x89-08/13	999
1573-4_HBA1xLH51.9540-10F2org01Z182_95x89-08/13	999
1573-5_HBA1xLH51.9540-10F2org01Z182_95x89-08/13	999
1573-6_HBA1xLH51.9540-10F2org01Z182_95x89-08/13	999
1573-7_HBA1xLH51.9540-10F2org01Z182_95x89-08/13	999
1573-8_HBA1xLH51.9540-10F2org01Z182_95x89-08/13	999
1573-9_HBA1xLH51.9540-10F2org01Z182_95x89-08/13	999

3807

3807, a row of PHB47xZacatecas 182, was selfed, and the selfs were planted ear-to-row in an isolation block where they were evaluated for resistance to *gal* pollination during summer 2013. Of the seven isolation rows evaluated, six set one or zero seeds, producing uniformly bare ears. The remaining one set 100 kernels on the row, and segregated for bare ears within row. Results are presented in Table 75.

Table 75. Results of *gal* isolation block evaluation of 3807 F₂ lines from Zacatecas 182

Description	#K on Row	# Ears	Seg?
6684_B47/Maiz_Dulce-ZAC182_B_F2_3807-1/12	1	8	n
6685_B47/Maiz_Dulce-ZAC182_B_F2_3807-2/12	0	8	n
6686_B47/Maiz_Dulce-ZAC182_B_F2_3807-3/12	0	8	n
6687_B47/Maiz_Dulce-ZAC182_B_F2_3807-4/12	0	8	n
6688_B47/Maiz_Dulce-ZAC182_B_F2_3807-5/12	0	8	n
6689_B47/Maiz_Dulce-ZAC182_B_F2_3807-6/12	100	8	y
6690_B47/Maiz_Dulce-ZAC182_B_F2_3807-7/1	0	8	n

All of the selfs from the original F₁ row were planted ear-to-row in 2013 summer nursery, and were evaluated as individual plants. Of forty-two total top ears evaluated, twenty-eight set zero kernels, nine set less than ten kernels, four set 100 or fewer kernels, and one set 250 kernels on the top ear. Results are presented in Table 76.

Table 76. Results of *gal* nursery evaluation of 3807 F₂ lines from Zacatecas 182

Description	R13 Row	Top Ear #K
B47/Maiz_Dulce-ZAC182_B_F2_3807-1/12	551-01	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-1/12	551-02	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-1/12	551-03	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-1/12	551-04	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-1/12	551-05	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-1/12	551-06	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-1/12	551-07	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-1/12	551-08	1
B47/Maiz_Dulce-ZAC182_B_F2_3807-2/12	552-01	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-2/12	552-02	5
B47/Maiz_Dulce-ZAC182_B_F2_3807-2/12	552-03	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-2/12	552-04	6
B47/Maiz_Dulce-ZAC182_B_F2_3807-2/12	552-07	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-3/12	553-01	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-3/12	553-02	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-3/12	553-03a	100
B47/Maiz_Dulce-ZAC182_B_F2_3807-3/12	553-03b	90
B47/Maiz_Dulce-ZAC182_B_F2_3807-3/12	553-04	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-3/12	553-05	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-3/12	553-07	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-3/12	553-08	6
B47/Maiz_Dulce-ZAC182_B_F2_3807-4/12	554-01	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-4/12	554-03	30
B47/Maiz_Dulce-ZAC182_B_F2_3807-4/12	554-04	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-4/12	554-05	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-5/12	555-01	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-5/12	555-02	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-5/12	555-03	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-5/12	555-04	2
B47/Maiz_Dulce-ZAC182_B_F2_3807-6/12	556-01	20
B47/Maiz_Dulce-ZAC182_B_F2_3807-6/12	556-02	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-6/12	556-03	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-6/12	556-04	0
B47/Maiz_Dulce-ZAC182_B_F2_3807-6/12	556-05	0

Table 76. Continued

Description	R13 Row	Top Ear #K
B47/Maiz_Dulce-ZAC182_B_F2_3807-6/12	556-07	250

BC/Pseudo BCs

NC476x1349-5 was crossed again to NC476, creating BC₁ seed, which was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 77.

Table 77. Results of *gal* nursery evaluation of 1349-5 BC₁ lines from Zacatecas 182

Description	Top Ear #K
1533-1_NC476*2xZ182_BCS1_1349-5_8584x83-4/12	999
1533-2_NC476*2xZ182_BCS1_1349-5_8584x83-4/12	999
1533-3_NC476*2xZ182_BCS1_1349-5_8584x83-4/12	999
1533-4_NC476*2xZ182_BCS1_1349-5_8584x83-4/12	23
1533-5_NC476*2xZ182_BCS1_1349-5_8584x83-4/12	2
1533-6_NC476*2xZ182_BCS1_1349-5_8584x83-4/12	1
1533-7_NC476*2xZ182_BCS1_1349-5_8584x83-4/12	0
1533-8_NC476*2xZ182_BCS1_1349-5_8584x83-4/12	999
1533-9_NC476*2xZ182_BCS1_1349-5_8584x83-4/12	50

ICI581x1411-6, the same material as R13 row 1993-3 above (Table 63), was crossed to NC476, seed of which was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Appendix I Table 20.

ICI581x1411-9a, the same material as R13 row 1996-3 above (Table 63), was crossed to HBA1, seed of which was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 78.

Table 78. Results of *gal* nursery evaluation of 1411-9a pseudo-BC₁ lines from Zacatecas 182

Description	Top Ear #K
1531-1_HBAxI581.Z182S1_01411-9ar_1987x1996-3/13	999
1531-2_HBAxI581.Z182S1_01411-9ar_1987x1996-3/13	999
1531-3_HBAxI581.Z182S1_01411-9ar_1987x1996-3/13	1
1531-4_HBAxI581.Z182S1_01411-9ar_1987x1996-3/13	999
1531-5_HBAxI581.Z182S1_01411-9ar_1987x1996-3/13	xxx
1531-6_HBAxI581.Z182S1_01411-9ar_1987x1996-3/13	45
1531-7_HBAxI581.Z182S1_01411-9ar_1987x1996-3/13	999
1531-8_HBAxI581.Z182S1_01411-9ar_1987x1996-3/13	999
1531-9_HBAxI581.Z182S1_01411-9ar_1987x1996-3/13	999

NC476x1411-11 was crossed again to NC476, creating BC₁ seed, which was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 79.

Table 79. Results of *gal* nursery evaluation of 1411-11 BC₁ lines from Zacatecas 182

Description	Top Ear #K
1561-1_476*2xZ182BC1S1_000_1411-11_8592x91-3/12	999
1561-2_476*2xZ182BC1S1_000_1411-11_8592x91-3/12	xxx
1561-3_476*2xZ182BC1S1_000_1411-11_8592x91-3/12	30

Table 79. Continued

Description	Top Ear #K
1561-4_476*2xZ182BC1S1_000_1411-11_8592x91-3/12	25
1561-5_476*2xZ182BC1S1_000_1411-11_8592x91-3/12	999
1561-6_476*2xZ182BC1S1_000_1411-11_8592x91-3/12	2
1561-7_476*2xZ182BC1S1_000_1411-11_8592x91-3/12	999
1561-8_476*2xZ182BC1S1_000_1411-11_8592x91-3/12	0
1561-9_476*2xZ182BC1S1_000_1411-11_8592x91-3/12	xxx

LH132x9539-3, the same material as R13 row 193-1 above (Table 70), was crossed to NC368, seed of which was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Appendix I Table 21. NC368x9539-2, the same material as R13 row 249-5 above (Table 69), was crossed again to NC368, creating BC₁ seed, which was planted ear-to-row and evaluated for resistance to *gal* pollination. Results are presented in Appendix I Table 22. NC368x9539-4, the same material as R13 row 252-1 above (Table 69), was crossed again to NC368, creating BC₁ seed, which was planted ear-to-row and evaluated for resistance to *gal* pollination during summer 2014. Results are presented in Table 80.

Table 80. Results of *gal* nursery evaluation of 9539-4 BC₁ crosses from Zacatecas 182

Description	Top Ear #K
1565-1_NC368*2x9539-4_000Z182BCS1_101x252-01/13	20
1565-2_NC368*2x9539-4_000Z182BCS1_101x252-01/13	999
1565-3_NC368*2x9539-4_000Z182BCS1_101x252-01/13	2
1565-4_NC368*2x9539-4_000Z182BCS1_101x252-01/13	45
1565-5_NC368*2x9539-4_000Z182BCS1_101x252-01/13	0

Table 80. Continued

Description	Top Ear #K
1565-6 NC368*2x9539-4_000Z182BCS1_101x252-01/13	999
1565-7 NC368*2x9539-4_000Z182BCS1_101x252-01/13	999
1565-8 NC368*2x9539-4_000Z182BCS1_101x252-01/13	999
1565-9 NC368*2x9539-4_000Z182BCS1_101x252-01/13	2

NC368x9539-5, the same material as R13 row 253-4 above (Table 69), was crossed again to NC368, creating BC₁ seed, which was planted ear-to-row and evaluated for resistance to *gal* pollination during summer 2014. Results are presented in Table 81.

Table 81. Results of *gal* nursery evaluation of 9539-5 BC₁ lines from Zacatecas 182

Description	Top Ear #K
1566-1 NC368*2x9539-5_004Z182BCS1_101x253-04/13	25
1566-2 NC368*2x9539-5_004Z182BCS1_101x253-04/13	30
1566-3 NC368*2x9539-5_004Z182BCS1_101x253-04/13	120
1566-4 NC368*2x9539-5_004Z182BCS1_101x253-04/13	999
1566-5 NC368*2x9539-5_004Z182BCS1_101x253-04/13	999
1566-6 NC368*2x9539-5_004Z182BCS1_101x253-04/13	100
1566-7 NC368*2x9539-5_004Z182BCS1_101x253-04/13	999
1566-8 NC368*2x9539-5_004Z182BCS1_101x253-04/13	999
1566-9 NC368*2x9539-5_004Z182BCS1_101x253-04/13	999

NC368x(LH132x9539-5), derived from R13 row 194-8 above (Table 70), was crossed again to NC368, creating BC₁ seed, which was planted ear-to-row and evaluated for resistance to *gal* pollination during summer 2014. Results are presented in Table 82.

NC368x9539-9, the same material as R13 row 256-1 above (Table 69), was crossed again to NC368, creating BC₁ seed, which was planted ear-to-row and evaluated for resistance to *gal* pollination during summer nursery 2014. Results are presented in Table 84.

Table 84. Results of *gal* nursery evaluation of 9539-9 BC₁ crosses from Zacatecas 182

Description	Top Ear #K
1568-1 NC368*2x9539-9 Z182BCS1 101x256-01/13	4
1568-2 NC368*2x9539-9 Z182BCS1 101x256-01/13	999
1568-3 NC368*2x9539-9 Z182BCS1 101x256-01/13	999
1568-4 NC368*2x9539-9 Z182BCS1 101x256-01/13	55
1568-5 NC368*2x9539-9 Z182BCS1 101x256-01/13	999
1568-6 NC368*2x9539-9 Z182BCS1 101x256-01/13	30
1568-7 NC368*2x9539-9 Z182BCS1 101x256-01/13	999
1568-8 NC368*2x9539-9 Z182BCS1 101x256-01/13	999
1568-9 NC368*2x9539-9 Z182BCS1 101x256-01/13	0

NC368x9539-10, the same material as R13 row 257-3 above (Table 69), was crossed again to NC368, creating BC₁ seed, which was planted ear-to-row and evaluated for resistance to *gal* pollination during summer nursery 2014. Results are presented in Table 85.

Table 85. Results of *gal* nursery evaluation of 9539-10 BC₁ crosses from Zacatecas 182

Description	Top Ear #K
1569-1 NC368*2x9539-10 00Z182BCS1 101x257-03/13	999
1569-2 NC368*2x9539-10 00Z182BCS1 101x257-03/13	999
1569-3 NC368*2x9539-10 00Z182BCS1 101x257-03/13	999

Table 85. Continued

Description	Top Ear #K
1569-4 NC368*2x9539-10_00Z182BCS1_101x257-03/13	999
1569-5 NC368*2x9539-10_00Z182BCS1_101x257-03/13	xxx
1569-6 NC368*2x9539-10_00Z182BCS1_101x257-03/13	999
1569-7 NC368*2x9539-10_00Z182BCS1_101x257-03/13	999
1569-8 NC368*2x9539-10_00Z182BCS1_101x257-03/13	6
1569-9 NC368*2x9539-10_00Z182BCS1_101x257-03/13	999

NC368x9540-3, the same material as R13 row 260-3 above (Table 73), was crossed again to NC368, creating BC₁ seed, which was planted ear-to-row and evaluated for resistance to *gal* pollination during summer nursery 2014. Results are presented in Table 86.

Table 86. Results of *gal* nursery evaluation of 9540-3 BC₁ crosses from Zacatecas 182

Description	Top Ear #K
1572-1 NC368*2x9540-03S1_000_Z182_101x260-03/13	3
1572-2 NC368*2x9540-03S1_000_Z182_101x260-03/13	3
1572-3 NC368*2x9540-03S1_000_Z182_101x260-03/13	999
1572-4 NC368*2x9540-03S1_000_Z182_101x260-03/13	50
1572-5 NC368*2x9540-03S1_000_Z182_101x260-03/13	999
1572-6 NC368*2x9540-03S1_000_Z182_101x260-03/13	0
1572-7 NC368*2x9540-03S1_000_Z182_101x260-03/13	999
1572-8 NC368*2x9540-03S1_000_Z182_101x260-03/13	0
1572-9 NC368*2x9540-03S1_000_Z182_101x260-03/13	0

Guanajuato 100

F₁s

9529 and 9530, two rows of Guanajuato 100, were crossed as male to LH132, planted ear-to-row, and evaluated for resistance to *gal* pollination in an isolation block during summer 2013. Results are presented in Table 87.

Table 87. Results of *gal* isolation block evaluation of 9529 F₁ crosses from Guanajuato 100

Description	#K	# Ears For Type	Seg?
6059_LH132xMaizDul-GTO100__9501x9529-01/12	0	3	s
6060_LH132xMaizDul-GTO100__9501x9529-02/12	500	0	n
6061_LH132xMaizDul-GTO100__9501x9529-04/12	10	1	-
6062_LH132xMaizDul-GTO100__9501x9529-06/12	4	8	g
6063_LH132xMaizDul-GTO100__9501x9529-08/12	34	5	s
6064_LH132xMaizDul-GTO100__9501x9529-09/12	10	1	-
6065_LH132xMaizDul-GTO100__9501x9529-13/12	20	8	g
6066_LH132xMaizDul-GTO100__9501x9530-01/12	7	4	g
6067_LH132xMaizDul-GTO100__9501x9530-05/12	2	2	g
6068_LH132xMaizDul-GTO100__9501x9530-06/12	3	1	s
6069_LH132xMaizDul-GTO100__9501x9530-08/12	30	2	s
6070_LH132xMaizDul-GTO100__9501x9530-09/12	2	1	-
6071_LH132xMaizDul-GTO100__9501x9530-11/12	999	0	n

9529-1, 9529-4 and 9529-9, the same sources as isolation rows 6059, 6061 and 6064 above (Table 87), were crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination during summer nursery 2013. Results are presented in Table 88.

Table 88. Results of *gal* nursery evaluation of LH132x9529 F₁ crosses from Guanajuato 100

Description	R13 Row	Top Ear #K
GTO100_LH132x9529-01/12	136-01	0
GTO100_LH132x9529-01/12	136-02	0
GTO100_LH132x9529-01/12	136-03	0
GTO100_LH132x9529-01/12	136-04	0
GTO100_LH132x9529-01/12	136-05	0
GTO100_LH132x9529-01/12	136-06	1
GTO100_LH132x9529-01/12	136-07	1
GTO100_LH132x9529-01/12	136-08	0
GTO100_LH132x9529-04/12	137-01	2
GTO100_LH132x9529-04/12	137-02	0
GTO100_LH132x9529-04/12	137-03	0
GTO100_LH132x9529-04/12	137-04	1
GTO100_LH132x9529-04/12	137-05	0
GTO100_LH132x9529-04/12	137-06	3
GTO100_LH132x9529-04/12	137-07	0
GTO100_LH132x9529-04/12	137-08	0
GTO100_LH132x9529-04/12	137-09	0
GTO100_LH132x9529-09/12	138-01	0
GTO100_LH132x9529-09/12	138-02	0
GTO100_LH132x9529-09/12	138-04	xxx
GTO100_LH132x9529-09/12	138-05	1
GTO100_LH132x9529-09/12	138-06	0
GTO100_LH132x9529-09/12	138-07	0
GTO100_LH132x9529-09/12	138-08	0
GTO100_LH132x9529-09/12	138-09	0

9529-2 9529-6, and 9529-8, the same sources as isolation rows 6060, 6062 and 6063 above (Table 87), were crossed as male to NC368, planted ear-to-row and evaluated for resistance to *gal* pollination during summer nursery 2013. Results are presented in Table 89.

Table 89. Results of *gal* nursery evaluation of NC368x9529 F₁ crosses from Guanajuato 100

Description	R13 Row	Top Ear #K
GTO100_NC368x9529-02/12	201-01	1
GTO100_NC368x9529-02/12	201-02	1
GTO100_NC368x9529-02/12	201-03	1
GTO100_NC368x9529-02/12	201-04	xxx
GTO100_NC368x9529-02/12	201-05	10
GTO100_NC368x9529-02/12	201-06	4
GTO100_NC368x9529-02/12	201-07	5
GTO100_NC368x9529-02/12	201-08	15
GTO100_NC368x9529-02/12	201-09	1
GTO100_NC368x9529-06/12	202-01	10
GTO100_NC368x9529-06/12	202-02	0
GTO100_NC368x9529-06/12	202-03	xxx
GTO100_NC368x9529-06/12	202-04	1
GTO100_NC368x9529-06/12	202-05	xxx
GTO100_NC368x9529-06/12	202-06	>50
GTO100_NC368x9529-06/12	202-07	10
GTO100_NC368x9529-06/12	202-08	0
GTO100_NC368x9529-06/12	202-09	xxx
GTO100_NC368x9529-08/12	203-01	1
GTO100_NC368x9529-08/12	203-02	4
GTO100_NC368x9529-08/12	203-03	>50
GTO100_NC368x9529-08/12	203-04	2
GTO100_NC368x9529-08/12	203-05	xxx
GTO100_NC368x9529-08/12	203-06	10
GTO100_NC368x9529-08/12	203-07	3
GTO100_NC368x9529-08/12	203-08	10
GTO100_NC368x9529-08/12	203-09	5

9529-9 was also crossed to LH51 and similarly evaluated for resistance to *gal* pollination.

Results are presented in Table 90.

Table 90. Results of *gal* nursery evaluation of 9529-9 F₁ crosses from Guanajuato 100

Description	R13 Row	Top Ear #K
GTO100_LH51x9529-09/12	85-01	>50
GTO100_LH51x9529-09/12	85-02	>50
GTO100_LH51x9529-09/12	85-03	>50
GTO100_LH51x9529-09/12	85-04	>50
GTO100_LH51x9529-09/12	85-05	>50
GTO100_LH51x9529-09/12	85-06	>50
GTO100_LH51x9529-09/12	85-07	>50
GTO100_LH51x9529-09/12	85-08	>50
GTO100_LH51x9529-09/12	85-09	>50

9529-13, the same source as isolation row 6065 above (Table 87), was crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Of the nine individual plants evaluated, all nine set zero kernels on the top ear. Results are presented in Table 91.

Table 91. Results of *gal* nursery evaluation of 9529-13 F₁ crosses from Guanajuato 100

Description	Top Ear #K
1506-1_LH132xMaizDul-GTO100_9501x9529-13/12	0
1506-2_LH132xMaizDul-GTO100_9501x9529-13/12	0
1506-3_LH132xMaizDul-GTO100_9501x9529-13/12	0
1506-4_LH132xMaizDul-GTO100_9501x9529-13/12	0
1506-5_LH132xMaizDul-GTO100_9501x9529-13/12	0
1506-6_LH132xMaizDul-GTO100_9501x9529-13/12	0
1506-7_LH132xMaizDul-GTO100_9501x9529-13/12	0
1506-8_LH132xMaizDul-GTO100_9501x9529-13/12	0
1506-9_LH132xMaizDul-GTO100_9501x9529-13/12	0

9530-1, 9530-5, and 9530-9 the same sources as isolation rows 6066, 6067, and 6070 above (Table 87), were crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 92.

Table 92. Results of *gal* nursery evaluation of 2014 LH132x9530 F₁ crosses from Guanajuato 100

Description		Top Ear #K
1507-1	LH132xMaizDul-GTO100 9501x9530-01/12	0
1507-2	LH132xMaizDul-GTO100 9501x9530-01/12	2
1507-3	LH132xMaizDul-GTO100 9501x9530-01/12	0
1507-4	LH132xMaizDul-GTO100 9501x9530-01/12	1
1507-5	LH132xMaizDul-GTO100 9501x9530-01/12	0
1507-6	LH132xMaizDul-GTO100 9501x9530-01/12	55
1507-7	LH132xMaizDul-GTO100 9501x9530-01/12	0
1507-8	LH132xMaizDul-GTO100 9501x9530-01/12	0
1507-9	LH132xMaizDul-GTO100 9501x9530-01/12	xxx
1508-1	LH132xMaizDul-GTO100 9501x9530-05/12	0
1508-2	LH132xMaizDul-GTO100 9501x9530-05/12	0
1508-3	LH132xMaizDul-GTO100 9501x9530-05/12	999
1508-4	LH132xMaizDul-GTO100 9501x9530-05/12	85
1508-5	LH132xMaizDul-GTO100 9501x9530-05/12	1
1508-6	LH132xMaizDul-GTO100 9501x9530-05/12	55
1508-7	LH132xMaizDul-GTO100 9501x9530-05/12	0
1508-8	LH132xMaizDul-GTO100 9501x9530-05/12	0
1508-9	LH132xMaizDul-GTO100 9501x9530-05/12	0
1511-1	LH132xMaizDul-GTO100 9501x9530-09/12	0
1511-2	LH132xMaizDul-GTO100 9501x9530-09/12	0
1511-3	LH132xMaizDul-GTO100 9501x9530-09/12	2
1511-4	LH132xMaizDul-GTO100 9501x9530-09/12	8
1511-5	LH132xMaizDul-GTO100 9501x9530-09/12	10
1511-6	LH132xMaizDul-GTO100 9501x9530-09/12	0
1511-7	LH132xMaizDul-GTO100 9501x9530-09/12	0
1511-8	LH132xMaizDul-GTO100 9501x9530-09/12	0

Table 92. Continued

Description	Top Ear #K
1511-9_LH132xMaizDul-GTO100_9501x9530-09/12	0

9530-6 and 9530-8 the same source as isolation row 6068 and 6079 above (Table 87), were crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2013. Results are presented in Table 93.

Table 93. Results of *gal* nursery evaluation of 2013 LH132x9530 F₁ crosses from Guanajuato 100

Description	R13 Row	Top Ear #K
GTO100_LH132x9530-06/12	139-01	0
GTO100_LH132x9530-06/12	139-02	0
GTO100_LH132x9530-06/12	139-03	xxx
GTO100_LH132x9530-06/12	139-04	xxx
GTO100_LH132x9530-06/12	139-05	5
GTO100_LH132x9530-06/12	139-06	0
GTO100_LH132x9530-06/12	139-07	0
GTO100_LH132x9530-06/12	139-08	0
GTO100_LH132x9530-06/12	139-09	0
GTO100_LH132x9530-08/12	140-01	0
GTO100_LH132x9530-08/12	140-02	0
GTO100_LH132x9530-08/12	140-03	2
GTO100_LH132x9530-08/12	140-04	xxx
GTO100_LH132x9530-08/12	140-05	0
GTO100_LH132x9530-08/12	140-06	4
GTO100_LH132x9530-08/12	140-07	0
GTO100_LH132x9530-08/12	140-08	>50

9530-8 was also crossed to LH51 and similarly evaluated. This resulted in six plants, two of which set zero kernels, and the remaining four set fifty or fewer kernels on the top ear.

Results are presented in Table 94.

Table 94. Results of *gal* nursery evaluation of 9530-8 F₁ crosses from Guanajuato 100

Description	R13 Row	Top Ear #K
GTO100_LH51x9530-08/12	86-01	xxx
GTO100_LH51x9530-08/12	86-02	0
GTO100_LH51x9530-08/12	86-03	xxx
GTO100_LH51x9530-08/12	86-04	15
GTO100_LH51x9530-08/12	86-05	50
GTO100_LH51x9530-08/12	86-06	0
GTO100_LH51x9530-08/12	86-07	20
GTO100_LH51x9530-08/12	86-08	30
GTO100_LH51x9530-08/12	86-09	xxx

BCs

LH132x9529-1, the same source as R13 row 136-6 above (Table 88), was crossed twice to NC368, producing BC₁ seed, which was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 95.

Table 95. Results of *gal* nursery evaluation of 9529-1 BC₁ crosses from Guanajuato 100

Description	Top Ear #K
1501-1_368*2x132.9529-1BCS1_0_G100_8562x61-5/13	999
1501-2_368*2x132.9529-1BCS1_0_G100_8562x61-5/13	999

Table 95. Continued

Description	Top Ear #K
1501-3_ 368*2x132.9529-1BCS1_ 0_ G100_ 8562x61-5/13	xxx
1501-4_ 368*2x132.9529-1BCS1_ 0_ G100_ 8562x61-5/13	999
1501-5_ 368*2x132.9529-1BCS1_ 0_ G100_ 8562x61-5/13	25
1501-6_ 368*2x132.9529-1BCS1_ 0_ G100_ 8562x61-5/13	150
1501-7_ 368*2x132.9529-1BCS1_ 0_ G100_ 8562x61-5/13	999
1501-8_ 368*2x132.9529-1BCS1_ 0_ G100_ 8562x61-5/13	0
1501-9_ 368*2x132.9529-1BCS1_ 0_ G100_ 8562x61-5/13	0

NC368x9529-2, the same source as R13 row 201-3 above (Table 89), was crossed twice to NC368, producing BC₂ seed, which was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 96.

Table 96. Results of *gal* nursery evaluation of 9529-2 BC₂ crosses from Guanajuato 100

Description	Top Ear #K
1502-4_ NC368*3x9529-2_ BC2S1_ 5_ G100_ 8586x85-1/13	0
1502-5_ NC368*3x9529-2_ BC2S1_ 5_ G100_ 8586x85-1/13	999
1502-6_ NC368*3x9529-2_ BC2S1_ 5_ G100_ 8586x85-1/13	999
1502-7_ NC368*3x9529-2_ BC2S1_ 5_ G100_ 8586x85-1/13	999
1502-8_ NC368*3x9529-2_ BC2S1_ 5_ G100_ 8586x85-1/13	999
1502-9_ NC368*3x9529-2_ BC2S1_ 5_ G100_ 8586x85-1/13	5

LH132x9529-4, the same material as R13 row 137-4 above (Table 88), was crossed to NC320, seed of which was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 97.

Table 97. Results of *gal* nursery evaluation of 9529-4 pseudo-BC₁ crosses from Guanajuato 100

Description	Top Ear #K
1503-1_320x132.9529-4pu01_GTO100_110x137-4/13	xxx
1503-2_320x132.9529-4pu01_GTO100_110x137-4/13	999
1503-3_320x132.9529-4pu01_GTO100_110x137-4/13	0
1503-4_320x132.9529-4pu01_GTO100_110x137-4/13	0
1503-5_320x132.9529-4pu01_GTO100_110x137-4/13	999
1503-6_320x132.9529-4pu01_GTO100_110x137-4/13	999
1503-7_320x132.9529-4pu01_GTO100_110x137-4/13	xxx
1503-8_320x132.9529-4pu01_GTO100_110x137-4/13	999
1503-9_320x132.9529-4pu01_GTO100_110x137-4/13	0

NC368x9529-6, the same source as R13 row 202-4 above (Table 89), was crossed to NC320, then to PHT11. Seed of this cross was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 98.

Table 98. Results of *gal* nursery evaluation of 9529-6 pseudo-BC₁ crosses from Guanajuato 100

Description	Top Ear #K
1504-1_PHT11x20.68/9529-6_0G100_8393x8533-1/13	0
1504-2_PHT11x20.68/9529-6_0G100_8393x8533-1/13	0
1504-4_PHT11x20.68/9529-6_0G100_8393x8533-1/13	0
1504-5_PHT11x20.68/9529-6_0G100_8393x8533-1/13	999
1504-6_PHT11x20.68/9529-6_0G100_8393x8533-1/13	0
1504-7_PHT11x20.68/9529-6_0G100_8393x8533-1/13	0
1504-8_PHT11x20.68/9529-6_0G100_8393x8533-1/13	0
1504-9_PHT11x20.68/9529-6_0G100_8393x8533-1/13	999

LH132x9529-4, the same material as R13 row 203-1 above (Table 89), was crossed to NC320, seed of which was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 99.

Table 99. Results of *gal* nursery evaluation of 9529-8 pseudo-BC₁ crosses from Guanajuato 100

Description	Top Ear #K
1505-1_320x368.9529-8_001_GT100_110x203-01/13	xxx
1505-2_320x368.9529-8_001_GT100_110x203-01/13	xxx
1505-3_320x368.9529-8_001_GT100_110x203-01/13	999
1505-4_320x368.9529-8_001_GT100_110x203-01/13	0
1505-5_320x368.9529-8_001_GT100_110x203-01/13	999
1505-6_320x368.9529-8_001_GT100_110x203-01/13	999
1505-7_320x368.9529-8_001_GT100_110x203-01/13	2
1505-8_320x368.9529-8_001_GT100_110x203-01/13	0
1505-9_320x368.9529-8_001_GT100_110x203-01/13	999

LH132x9530-6, the same material as R13 row 139-9 above (Table 93), was crossed to NC320, seed of which was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 100.

Table 100. Results of *gal* nursery evaluation of 9530-6 pseudo-BC₁ crosses from Guanajuato 100

Description	Top Ear #K
1509-1_320x132.9530-6_000_GT100_110x139-09/13	0
1509-2_320x132.9530-6_000_GT100_110x139-09/13	999
1509-4_320x132.9530-6_000_GT100_110x139-09/13	30

Table 100. Continued

Description	Top Ear #K
1509-5 320x132.9530-6 000 GT100 110x139-09/13	999
1509-6 320x132.9530-6 000 GT100 110x139-09/13	0
1509-7 320x132.9530-6 000 GT100 110x139-09/13	999
1509-8 320x132.9530-6 000 GT100 110x139-09/13	0
1509-9 320x132.9530-6 000 GT100 110x139-09/13	999

LH132x9530-8, the same material as R13 row 140-1 above (Table 93), was crossed to NC368, seed of which was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 101.

Table 101. Results of *gal* nursery evaluation of 9530-8 pseudo-BC₁ crosses from Guanajuato 100

Description	Top Ear #K
1510-1 368x132.9530-8 GT100 101x140-01/13	0
1510-2 368x132.9530-8 GT100 101x140-01/13	999
1510-3 368x132.9530-8 GT100 101x140-01/13	xxx
1510-4 368x132.9530-8 GT100 101x140-01/13	999
1510-5 368x132.9530-8 GT100 101x140-01/13	999
1510-6 368x132.9530-8 GT100 101x140-01/13	2
1510-7 368x132.9530-8 GT100 101x140-01/13	4
1510-8 368x132.9530-8 GT100 101x140-01/13	999
1510-9 368x132.9530-8 GT100 101x140-01/13	999

Guanajuato 141

F₁s

9531, a row of Guanajuato 141, was crossed as male to LH132, planted ear-to-row, and evaluated for resistance to *gal* pollination in an isolation block during summer 2013. Results are presented in Table 102.

Table 102. Results of *gal* isolation block evaluation of 9531 F₁ crosses from Guanajuato 141

Description	#K	# Ears For Type	Seg?
6072_LH132xMaizDul-GTO141____9501x9531-01/12	999	0	n
6073_LH132xMaizDul-GTO141____9501x9531-05/12	0	2	s
6074_LH132xMaizDul-GTO141____9501x9531-07/12	5	8	g
6075_LH132xMaizDul-GTO141____9501x9531-08/12	0	2	s
6076_LH132xMaizDul-GTO141____9501x9531-09/12	20	8	g
6077_LH132xMaizDul-GTO141____9501x9531-11/12	5	8	g
6078_LH132xMaizDul-GTO141____9501x9531-12/12	0	6	g

9532, a row of Guanajuato 141, was crossed as male to LH132 (9532-1 to PHT60), planted ear-to-row, and evaluated for resistance to *gal* pollination in an isolation block during summer 2013. Results are presented in Table 103.

Table 103. Results of *gal* isolation block evaluation of 9532 F₁ crosses from Guanajuato 141

Description	#K	# Ears For Type	Seg?
6079_PHT60xMaizDul-GTO141____9554x9532-01/12	100	8	?
6080_LH132xMaizDul-GTO141____9501x9532-02/12	5	3	?
6081_LH132xMaizDul-GTO141____9501x9532-03/12	0	4	s
6082_LH132xMaizDul-GTO141____9501x9532-06/12	3	8	g
6083_LH132xMaizDul-GTO141____9501x9532-07/12	5	8	g
6084_LH132xMaizDul-GTO141____9501x9532-08/12	15	1	?
6085_LH132xMaizDul-GTO141____9501x9532-10/12	15	8	g
6086_LH132xMaizDul-GTO141____9501x9532-11/12	2	3	s
6087_LH132xMaizDul-GTO141____9501x9532-14/12	2	7	g

9531-5 and 9531-9, the same sources as isolation rows 6073 and 6076 above (Table 102), were crossed as male to NC368, planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2013. Results are presented in Table 104.

Table 104. Results of *gal* nursery evaluation of NC368x9531 F₁ crosses from Guanajuato 141

Description	R13 Row	Top Ear #K
GTO141_NC368x9531-05/12	204-01	10
GTO141_NC368x9531-05/12	204-02	xxx
GTO141_NC368x9531-05/12	204-03	0
GTO141_NC368x9531-05/12	204-04	0
GTO141_NC368x9531-05/12	204-05	15
GTO141_NC368x9531-05/12	204-06	15
GTO141_NC368x9531-05/12	204-07	>50
GTO141_NC368x9531-05/12	204-08	10
GTO141_NC368x9531-05/12	204-09	2
GTO141_NC368x9531-09/12	205-01	25

Table 104. Continued

Description	R13 Row	Top Ear #K
GTO141_NC368x9531-09/12	205-02	5
GTO141_NC368x9531-09/12	205-03	0
GTO141_NC368x9531-09/12	205-04	xxx
GTO141_NC368x9531-09/12	205-05	1
GTO141_NC368x9531-09/12	205-06	5
GTO141_NC368x9531-09/12	205-07	0
GTO141_NC368x9531-09/12	205-08	xxx
GTO141_NC368x9531-09/12	205-09	10

9531-7, 9531-8 and 9531-12, the same sources as isolation rows 6074, 6075 and 6078 above (Table 102), were crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2013. Results are presented in Table 105.

Table 105. Results of *gal* nursery evaluation of LH132x9531 F₁ crosses from Guanajuato 141

Description	R13 Row	Top Ear #K
GTO141_LH132x9531-07/12	141-01	10
GTO141_LH132x9531-07/12	141-02	15
GTO141_LH132x9531-07/12	141-03	0
GTO141_LH132x9531-07/12	141-04	0
GTO141_LH132x9531-07/12	141-05	10
GTO141_LH132x9531-07/12	141-06	0
GTO141_LH132x9531-07/12	141-07	0
GTO141_LH132x9531-07/12	141-08	0
GTO141_LH132x9531-07/12	141-09	6
GTO141_LH132x9531-08/12	142-01	0
GTO141_LH132x9531-08/12	142-02	0

Table 105. Continued

Description	R13 Row	Top Ear #K
GTO141_LH132x9531-08/12	142-03	0
GTO141_LH132x9531-08/12	142-04	5
GTO141_LH132x9531-08/12	142-05	xxx
GTO141_LH132x9531-08/12	142-06	xxx
GTO141_LH132x9531-08/12	142-07	xxx
GTO141_LH132x9531-08/12	142-08	0
GTO141_LH132x9531-08/12	142-09	0
GTO141_LH132x9531-12/12	143-01	0
GTO141_LH132x9531-12/12	143-02	0
GTO141_LH132x9531-12/12	143-03	10
GTO141_LH132x9531-12/12	143-04	0
GTO141_LH132x9531-12/12	143-05	9
GTO141_LH132x9531-12/12	143-06	0
GTO141_LH132x9531-12/12	143-07	xxx
GTO141_LH132x9531-12/12	143-08	0
GTO141_LH132x9531-12/12	143-09	0

9531-9, the same source as isolation row 6076 above (Table 102), was crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2013. Results are presented in Table 106.

Table 106. Results of *gal* nursery evaluation of LH51x9531-9 F₁ crosses from Guanajuato 141

Description	R13 Row	Top Ear #K
GTO141_LH51x9531-09/12	87-01	xxx
GTO141_LH51x9531-09/12	87-02	15
GTO141_LH51x9531-09/12	87-03	xxx

Table 106. Continued

Description	R13 Row	Top Ear #K
GTO141_LH51x9531-09/12	87-04	xxx
GTO141_LH51x9531-09/12	87-05	0
GTO141_LH51x9531-09/12	87-06	3
GTO141_LH51x9531-09/12	87-07	xxx
GTO141_LH51x9531-09/12	87-08	xxx
GTO141_LH51x9531-09/12	87-09	0

9531-11, the same source as isolation row 6077 above (Table 102), was crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 107.

Table 107. Results of *gal* nursery evaluation of 9531-11 F₁ crosses from Guanajuato 141

Description	Top Ear #K
1516-1_LH132xMaizDul-GTO141_9501x9531-11/12	0
1516-2_LH132xMaizDul-GTO141_9501x9531-11/12	0
1516-3_LH132xMaizDul-GTO141_9501x9531-11/12	0
1516-4_LH132xMaizDul-GTO141_9501x9531-11/12	0
1516-5_LH132xMaizDul-GTO141_9501x9531-11/12	1
1516-6_LH132xMaizDul-GTO141_9501x9531-11/12	0
1516-7_LH132xMaizDul-GTO141_9501x9531-11/12	15
1516-8_LH132xMaizDul-GTO141_9501x9531-11/12	4
1516-9_LH132xMaizDul-GTO141_9501x9531-11/12	12

9532-2, the same source as isolation row 6080 above (Table 102), was crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 108.

Table 108. Results of *gal* nursery evaluation of 9532-2 F₁ crosses from Guanajuato 141

Description		Top Ear #K
1518-1	LH132xMaizDul-GTO141_9501x9532-02/12	12
1518-2	LH132xMaizDul-GTO141_9501x9532-02/12	35
1518-3	LH132xMaizDul-GTO141_9501x9532-02/12	xxx
1518-4	LH132xMaizDul-GTO141_9501x9532-02/12	0
1518-5	LH132xMaizDul-GTO141_9501x9532-02/12	0
1518-6	LH132xMaizDul-GTO141_9501x9532-02/12	0
1518-7	LH132xMaizDul-GTO141_9501x9532-02/12	0
1518-8	LH132xMaizDul-GTO141_9501x9532-02/12	0
1518-9	LH132xMaizDul-GTO141_9501x9532-02/12	xxx

9532-3, 9532-6 through 9532-10, and 9532-14, the same sources as isolation row 6081 through 6085 and 6087, respectively, above (Table 103), were crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2013. Results are presented in Table 109.

Table 109. Results of *gal* nursery evaluation of LH132x9532 F₁ crosses from Guanajuato 141

Description	R13 Row	Top Ear #K
GTO141_LH132x9532-03/12	144-01	0
GTO141_LH132x9532-03/12	144-02	0

Table 109. Continued

Description	R13 Row	Top Ear #K
GTO141_LH132x9532-03/12	144-03	0
GTO141_LH132x9532-03/12	144-04	xxx
GTO141_LH132x9532-03/12	144-05	0
GTO141_LH132x9532-03/12	144-06	5
GTO141_LH132x9532-03/12	144-07	0
GTO141_LH132x9532-03/12	144-08	0
GTO141_LH132x9532-03/12	144-09	0
GTO141_LH132x9532-06/12	145-01	0
GTO141_LH132x9532-06/12	145-02	3
GTO141_LH132x9532-06/12	145-03	0
GTO141_LH132x9532-06/12	145-04	0
GTO141_LH132x9532-06/12	145-05	0
GTO141_LH132x9532-06/12	145-06	0
GTO141_LH132x9532-06/12	145-07	0
GTO141_LH132x9532-06/12	145-08	0
GTO141_LH132x9532-06/12	145-09	0
GTO141_LH132x9532-07/12	146-01	0
GTO141_LH132x9532-07/12	146-02	0
GTO141_LH132x9532-07/12	146-03	0
GTO141_LH132x9532-07/12	146-04	0
GTO141_LH132x9532-07/12	146-05	0
GTO141_LH132x9532-07/12	146-06	5
GTO141_LH132x9532-07/12	146-07	0
GTO141_LH132x9532-07/12	146-08	0
GTO141_LH132x9532-07/12	146-09	0
GTO141_LH132x9532-08/12	147-01	>50
GTO141_LH132x9532-08/12	147-02	xxx
GTO141_LH132x9532-08/12	147-03	0
GTO141_LH132x9532-08/12	147-04	xxx
GTO141_LH132x9532-08/12	147-05	0
GTO141_LH132x9532-08/12	147-06	xxx
GTO141_LH132x9532-08/12	147-07	10
GTO141_LH132x9532-08/12	147-08	xxx
GTO141_LH132x9532-08/12	147-09	0

Table 109. Continued

Description	R13 Row	Top Ear #K
GTO141_LH132x9532-10/12	148-01	0
GTO141_LH132x9532-10/12	148-02	0
GTO141_LH132x9532-10/12	148-03	3
GTO141_LH132x9532-10/12	148-07	0
GTO141_LH132x9532-10/12	148-08	0
GTO141_LH132x9532-14/12	149-01	1
GTO141_LH132x9532-14/12	149-02	30
GTO141_LH132x9532-14/12	149-03	0
GTO141_LH132x9532-14/12	149-04	0
GTO141_LH132x9532-14/12	149-05	0
GTO141_LH132x9532-14/12	149-06	0
GTO141_LH132x9532-14/12	149-07	0
GTO141_LH132x9532-14/12	149-08	0
GTO141_LH132x9532-14/12	149-09	25

9532-11, the same source as isolation row 6086 above (Table 103), was crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Of the nine individual plants evaluated, eight set ten or fewer kernels, and the other one set twenty-five kernels on the top ear. Results are presented in Table 110.

Table 110. Results of *gal* nursery evaluation of 9532-11 F₁ crosses from Guanajuato 141

Description	Top Ear #K
1523-1_LH132xMaizDul-GTO141_9501x9532-11/12	10
1523-2_LH132xMaizDul-GTO141_9501x9532-11/12	1
1523-3_LH132xMaizDul-GTO141_9501x9532-11/12	0
1523-4_LH132xMaizDul-GTO141_9501x9532-11/12	25

Table 110. Continued

Description	Top Ear #K
1523-5 LH132xMaizDul-GTO141 9501x9532-11/12	0
1523-6 LH132xMaizDul-GTO141 9501x9532-11/12	3
1523-7 LH132xMaizDul-GTO141 9501x9532-11/12	2
1523-8 LH132xMaizDul-GTO141 9501x9532-11/12	6
1523-9 LH132xMaizDul-GTO141 9501x9532-11/12	0

BCs/Pseudo-BCs

NC368x9531-5, the same material as R13 row 204-4 (Table 104), was crossed as male to NC320.NC368, then to NKW85. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 111.

Table 111. Results of *gal* nursery evaluation of 9531-5 pseudo-BC crosses from Guanajuato 141

Description	Top Ear #K
1512-1_NKW85x20.8/9531-5r0G141_9621x8537-2/13	999
1512-2_NKW85x20.8/9531-5r0G141_9621x8537-2/13	999
1512-3_NKW85x20.8/9531-5r0G141_9621x8537-2/13	0
1512-4_NKW85x20.8/9531-5r0G141_9621x8537-2/13	999
1512-5_NKW85x20.8/9531-5r0G141_9621x8537-2/13	0
1512-6_NKW85x20.8/9531-5r0G141_9621x8537-2/13	0
1512-7_NKW85x20.8/9531-5r0G141_9621x8537-2/13	999
1512-8_NKW85x20.8/9531-5r0G141_9621x8537-2/13	999
1512-9_NKW85x20.8/9531-5r0G141_9621x8537-2/13	0

LH132x9531-7, the same material as R13 row 141-4 (Table 105), was crossed as male to NC320. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 112.

Table 112. Results of *gal* nursery evaluation of 9531-7 pseudo-BC crosses from Guanajuato 141

Description	Top Ear #K
1513-1_320x132.9531-7__GT141_110x141-04/13	0
1513-2_320x132.9531-7__GT141_110x141-04/13	0
1513-3_320x132.9531-7__GT141_110x141-04/13	999
1513-4_320x132.9531-7__GT141_110x141-04/13	999
1513-5_320x132.9531-7__GT141_110x141-04/13	0
1513-6_320x132.9531-7__GT141_110x141-04/13	0
1513-7_320x132.9531-7__GT141_110x141-04/13	0
1513-8_320x132.9531-7__GT141_110x141-04/13	0
1513-9_320x132.9531-7__GT141_110x141-04/13	0

LH132x9531-8, the same material as R13 row 142-1 (Table 105), was crossed as male to NC320. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 113.

Table 113. Results of *gal* nursery evaluation of 9531-8 pseudo-BC crosses from Guanajuato 141

Description	Top Ear #K
1514-1_368x132.9531-8__GTO141_101x142-1/13	999
1514-2_368x132.9531-8__GTO141_101x142-1/13	1

Table 113. Continued

Description	Top Ear #K
1514-3 368x132.9531-8 GTO141 101x142-1/13	0
1514-4 368x132.9531-8 GTO141 101x142-1/13	0
1514-5 368x132.9531-8 GTO141 101x142-1/13	999
1514-6 368x132.9531-8 GTO141 101x142-1/13	xxx
1514-7 368x132.9531-8 GTO141 101x142-1/13	18
1514-8 368x132.9531-8 GTO141 101x142-1/13	999

NC368x9531-9, the same material as R13 row 205-3 (Table 104), was crossed as male to NC368 twice, producing BC₂ seed. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 114.

Table 114. Results of *gal* nursery evaluation of 9531-9 BC₂ crosses from Guanajuato 141

Description	Top Ear #K
1515-1 368*3x9531-9BC2 GT141 8587x88-2/13	999
1515-2 368*3x9531-9BC2 GT141 8587x88-2/13	0
1515-3 368*3x9531-9BC2 GT141 8587x88-2/13	0
1515-4 368*3x9531-9BC2 GT141 8587x88-2/13	xxx
1515-5 368*3x9531-9BC2 GT141 8587x88-2/13	999
1515-6 368*3x9531-9BC2 GT141 8587x88-2/13	999
1515-7 368*3x9531-9BC2 GT141 8587x88-2/13	999
1515-8 368*3x9531-9BC2 GT141 8587x88-2/13	999

LH132x9531-12, the same material as R13 row 143-6 (Table 105), was crossed as male to NC368 twice, producing BC₁ seed. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 115.

Table 115. Results of *gal* nursery evaluation of 9531-12 BC₁ crosses from Guanajuato 141

Description	Top Ear #K
1517-1_368*2x132.9531-12BC_0G141_8566x65-3/13	75
1517-2_368*2x132.9531-12BC_0G141_8566x65-3/13	999
1517-3_368*2x132.9531-12BC_0G141_8566x65-3/13	0
1517-4_368*2x132.9531-12BC_0G141_8566x65-3/13	20
1517-5_368*2x132.9531-12BC_0G141_8566x65-3/13	50
1517-6_368*2x132.9531-12BC_0G141_8566x65-3/13	35
1517-7_368*2x132.9531-12BC_0G141_8566x65-3/13	999
1517-8_368*2x132.9531-12BC_0G141_8566x65-3/13	999
1517-9_368*2x132.9531-12BC_0G141_8566x65-3/13	1

LH132x9532-6, the same material as R13 row 145-1 (Table 109), was crossed as male to NC368. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 116.

Table 116. Results of *gal* nursery evaluation of 9532-6 pseudo-BC crosses from Guanajuato 141

Description	Top Ear #K
1519-1_368x132.9532-6_GTO141_101x145-01/13	999
1519-2_368x132.9532-6_GTO141_101x145-01/13	35
1519-3_368x132.9532-6_GTO141_101x145-01/13	0
1519-4_368x132.9532-6_GTO141_101x145-01/13	1

Table 116. Continued

Description	Top Ear #K
1519-5_368x132.9532-6_GTO141_101x145-01/13	999
1519-6_368x132.9532-6_GTO141_101x145-01/13	25
1519-7_368x132.9532-6_GTO141_101x145-01/13	0
1519-8_368x132.9532-6_GTO141_101x145-01/13	999
1519-9_368x132.9532-6_GTO141_101x145-01/13	35

LH132x9532-7, the same material as R13 row 146-1 (Table 109), was crossed as male to NC368. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 117.

Table 117. Results of *gal* nursery evaluation of 9532-7 BC crosses from Guanajuato 141

Description	Top Ear #K
1520-1_368x132.9532-7_GTO141_101x146-01/13	999
1520-2_368x132.9532-7_GTO141_101x146-01/13	999
1520-3_368x132.9532-7_GTO141_101x146-01/13	999
1520-4_368x132.9532-7_GTO141_101x146-01/13	999
1520-5_368x132.9532-7_GTO141_101x146-01/13	999
1520-6_368x132.9532-7_GTO141_101x146-01/13	45
1520-7_368x132.9532-7_GTO141_101x146-01/13	999
1520-8_368x132.9532-7_GTO141_101x146-01/13	15
1520-9_368x132.9532-7_GTO141_101x146-01/13	999

LH132x9532-8, the same material as R13 row 147-9 (Table 109), was crossed as male to NC368. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 118.

Table 118. Results of *gal* nursery evaluation of 9532-8 pseudo-BC crosses from Guanajuato 141

Description	Top Ear #K
1521-1_320x132.9532-8_GTO141_110x147-09/13	xxx
1521-2_320x132.9532-8_GTO141_110x147-09/13	0
1521-3_320x132.9532-8_GTO141_110x147-09/13	999
1521-4_320x132.9532-8_GTO141_110x147-09/13	999
1521-5_320x132.9532-8_GTO141_110x147-09/13	999
1521-6_320x132.9532-8_GTO141_110x147-09/13	999
1521-7_320x132.9532-8_GTO141_110x147-09/13	999
1521-8_320x132.9532-8_GTO141_110x147-09/13	100
1521-9_320x132.9532-8_GTO141_110x147-09/13	999

LH132x9532-10, the same material as R13 row 148-7 (Table 109), was crossed as male to NC320 twice, producing BC₁ seed. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 119.

Table 119. Results of *gal* nursery evaluation of NC320xLH132.9532-10 BC₁ crosses from Guanajuato 141

Description	Top Ear #K
1522-1_320*2x132.9532-10BC_1G141_8518x17-3/13	999
1522-2_320*2x132.9532-10BC_1G141_8518x17-3/13	0
1522-3_320*2x132.9532-10BC_1G141_8518x17-3/13	999

Table 119. Continued

Description	Top Ear #K
1522-4 320*2x132.9532-10BC_1G141_8518x17-3/13	xxx
1522-5 320*2x132.9532-10BC_1G141_8518x17-3/13	0
1522-6 320*2x132.9532-10BC_1G141_8518x17-3/13	0
1522-7 320*2x132.9532-10BC_1G141_8518x17-3/13	0
1522-8 320*2x132.9532-10BC_1G141_8518x17-3/13	999

LH132x9532-10, the same material as R13 row 148-2 (Table 109), was crossed as male to NC368 twice, producing BC₁ seed. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 120.

Table 120. Results of *gal* nursery evaluation of NC368xLH132.9532-10 BC₁ crosses from Guanajuato 141

Description	Top Ear #K
668-1 368*2x132.9532-10012G141_8567x8-4/13	500
668-2 368*2x132.9532-10012G141_8567x8-4/13	400
668-3 368*2x132.9532-10012G141_8567x8-4/13	250
668-4 368*2x132.9532-10012G141_8567x8-4/13	35
668-5 368*2x132.9532-10012G141_8567x8-4/13	2
668-6 368*2x132.9532-10012G141_8567x8-4/13	400
668-7 368*2x132.9532-10012G141_8567x8-4/13	250
668-8 368*2x132.9532-10012G141_8567x8-4/13	400
668-9 368*2x132.9532-10012G141_8567x8-4/13	0

LH132x9532-14, the same material as R13 row 149-7 (Table 109), was crossed as male to NC368. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 121.

Table 121. Results of *gal* nursery evaluation of 9532-14 pseudo-BC crosses from Guanajuato 141

Description	Top Ear #K
1524-1_368x132x9532-14_G141_101x149-07/13	999
1524-2_368x132x9532-14_G141_101x149-07/13	999
1524-3_368x132x9532-14_G141_101x149-07/13	3
1524-6_368x132x9532-14_G141_101x149-07/13	0
1524-7_368x132x9532-14_G141_101x149-07/13	999
1524-8_368x132x9532-14_G141_101x149-07/13	35

LH132x9532-14, the same material as R13 row 149-4 (Table 109), was crossed as male to PHB47. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in summer nursery 2014. Results are presented in Table 122.

Table 122. Results of additional *gal* nursery evaluation of 9532-14 pseudo-BC crosses from Guanajuato 141

Description	Top Ear #K
673-1_B47x132.9532-14d8_0G141_2401x149-4/13	400
673-2_B47x132.9532-14d8_0G141_2401x149-4/13	0
673-3_B47x132.9532-14d8_0G141_2401x149-4/13	300
673-4_B47x132.9532-14d8_0G141_2401x149-4/13	0
673-5_B47x132.9532-14d8_0G141_2401x149-4/13	0
673-6_B47x132.9532-14d8_0G141_2401x149-4/13	xxx

Table 122. Continued

Description	Top Ear #K
673-7_B47x132.9532-14d8_0G141_2401x149-4/13	0
673-8_B47x132.9532-14d8_0G141_2401x149-4/13	250
673-9_B47x132.9532-14d8_0G141_2401x149-4/13	300

Guanajuato 181

9533, a row of Guanajuato 181, was crossed as male to LH132 (9533-2 to LH195), planted ear-to-row, and evaluated for resistance to *gal* pollination in an isolation block during summer 2013. Results are presented in Table 123.

Table 123. Results of *gal* isolation block evaluation of 9533 F₁ crosses from Guanajuato 181

Description	#K	# Ears For Type	Seg?
6088_LH132xMaizDul-GTO181____9501x9533-01/12	5	3	?
6089_LH195xMaizDul-GTO181____9506x9533-02/12	0	2	s
6090_LH132xMaizDul-GTO181____9501x9533-03/12	20	4	s
6091_LH132xMaizDul-GTO181____9501x9533-04/12	5	1	?
6092_LH132xMaizDul-GTO181____9501x9533-06/12	32	6	g
6093_LH132xMaizDul-GTO181____9501x9533-09/12	36	4	?
6094_LH132xMaizDul-GTO181____9501x9533-11/12	0	3	s

9534, a row of Guanajuato 181, was crossed as male to LH132(9534-7 to PHT60), planted ear-to-row, and evaluated for resistance to *gal* pollination in an isolation block during summer 2013. Results are presented in Table 124.

Table 124. Results of *gal* isolation block evaluation of 9534 F₁ crosses from Guanajuato 181

Description	#K	# Ears For Type	Seg?
6095_LH132xMaizDul-GTO181____9501x9534-01/12	0	2	g
6096_LH132xMaizDul-GTO181____9501x9534-04/12	6	3	g
6097_LH132xMaizDul-GTO181____9501x9534-05/12	5	7	g
6098_LH132xMaizDul-GTO181____9501x9534-06/12	4	2	s
6099_PHT60xMaizDul-GTO181____9554x9534-07/12	0	2	s
6100_LH132xMaizDul-GTO181____9501x9534-08/12	12	7	g
6101_LH132xMaizDul-GTO181____9501x9534-09/12	62	7	?

9533-1, 9533-3, 9533-4 and 9533-6, the same sources as isolation rows 6088 and 6090 through 6092 above (Table 123), were crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in 2013 summer nursery. Results are presented in Table 125.

Table 125. Results of *gal* nursery evaluation of LH132x9533 F₁ crosses from Guanajuato 181

Description	R13 Row	Top Ear #K
GTO181_LH132x9533-01/12	209-01	0
GTO181_LH132x9533-01/12	209-02	1
GTO181_LH132x9533-01/12	209-03	>50
GTO181_LH132x9533-01/12	209-04	6
GTO181_LH132x9533-01/12	209-05	xxx
GTO181_LH132x9533-01/12	209-06	0
GTO181_LH132x9533-01/12	209-07	0
GTO181_LH132x9533-01/12	209-08	55
GTO181_LH132x9533-01/12	209-09	0
GTO181_LH132x9533-03/12	181-01	0
GTO181_LH132x9533-03/12	181-02	0

Table 125. Continued

Description	R13 Row	Top Ear #K
GTO181_LH132x9533-03/12	181-03	0
GTO181_LH132x9533-03/12	181-04	0
GTO181_LH132x9533-03/12	181-05	0
GTO181_LH132x9533-03/12	181-06	3
GTO181_LH132x9533-03/12	181-07	xxx
GTO181_LH132x9533-03/12	181-08	0
GTO181_LH132x9533-03/12	181-09	0
GTO181_LH132x9533-04/12	182-01	0
GTO181_LH132x9533-04/12	182-02	0
GTO181_LH132x9533-04/12	182-03	0
GTO181_LH132x9533-04/12	182-04	0
GTO181_LH132x9533-04/12	182-05	0
GTO181_LH132x9533-04/12	182-06	0
GTO181_LH132x9533-04/12	182-07	0
GTO181_LH132x9533-04/12	182-08	25
GTO181_LH132x9533-04/12	182-09	0
GTO181_LH132x9533-06/12	183-01	0
GTO181_LH132x9533-06/12	183-02	2
GTO181_LH132x9533-06/12	183-03	0
GTO181_LH132x9533-06/12	183-04	2
GTO181_LH132x9533-06/12	183-05	0
GTO181_LH132x9533-06/12	183-06	xxx
GTO181_LH132x9533-06/12	183-07	0
GTO181_LH132x9533-06/12	183-08	1
GTO181_LH132x9533-06/12	183-09	1

9533-1 was also crossed to LH51, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Table 126.

Table 126. Results of *gal* nursery evaluation of LH51x9533-1 F₁ crosses from Guanajuato 181

Description	R13 Row	Top Ear #K
GTO181_LH51x9533-01/12	88-01	>50
GTO181_LH51x9533-01/12	88-02	>50
GTO181_LH51x9533-01/12	88-03	>50
GTO181_LH51x9533-01/12	88-04	xxx
GTO181_LH51x9533-01/12	88-05	25
GTO181_LH51x9533-01/12	88-06	>50
GTO181_LH51x9533-01/12	88-07	>50
GTO181_LH51x9533-01/12	88-08	1
GTO181_LH51x9533-01/12	88-09	0

9533-2, the same source as isolation row 6089 above (Table 123), was crossed as male to LH195, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Table 127.

Table 127. Results of *gal* nursery evaluation of 9533-2 F₁ crosses from Guanajuato 181

Description	R13 Row	Top Ear #K
GTO181_LH195x9533-02/12	261-01	0
GTO181_LH195x9533-02/12	261-02	0
GTO181_LH195x9533-02/12	261-03	0
GTO181_LH195x9533-02/12	261-04	0
GTO181_LH195x9533-02/12	261-05	0
GTO181_LH195x9533-02/12	261-06	0
GTO181_LH195x9533-02/12	261-07	0
GTO181_LH195x9533-02/12	261-08	0
GTO181_LH195x9533-02/12	261-09	xxx

9533-9 and 9533-11, the same sources as isolation rows 6093 and 6094 above (Table 123), were crossed as male to NC368, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Table 128.

Table 128. Results of *gal* nursery evaluation of NC368x9533 F₁ crosses from Guanajuato 181

Description	R13 Row	Top Ear #K
GTO181_NC368x9533-09/12	206-01	3
GTO181_NC368x9533-09/12	206-02	xxx
GTO181_NC368x9533-09/12	206-03	15
GTO181_NC368x9533-09/12	206-04	1
GTO181_NC368x9533-09/12	206-05	>50
GTO181_NC368x9533-09/12	206-06	0
GTO181_NC368x9533-09/12	206-07	10
GTO181_NC368x9533-09/12	206-08	10
GTO181_NC368x9533-09/12	206-09	15
GTO181_NC368x9533-11/12	207-01	6
GTO181_NC368x9533-11/12	207-02	2
GTO181_NC368x9533-11/12	207-03	xxx
GTO181_NC368x9533-11/12	207-04	6
GTO181_NC368x9533-11/12	207-05	15
GTO181_NC368x9533-11/12	207-06	15
GTO181_NC368x9533-11/12	207-07	10
GTO181_NC368x9533-11/12	207-08	xxx
GTO181_NC368x9533-11/12	207-09	10

9534-1, 9534-4, 9534-6 and 9534-9, the same sources as isolation rows 6095, 6096, 6098 and 6101 above (Table 124), were crossed as male to LH132, planted ear-to-row and evaluated

for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Table 129.

Table 129. Results of *gal* nursery evaluation of LH132x9534 F₁ crosses from Guanajuato 181

Description	R13 Row	Top Ear #K
GTO181_LH132x9534-01/12	184-01	0
GTO181_LH132x9534-01/12	184-02	10
GTO181_LH132x9534-01/12	184-03	0
GTO181_LH132x9534-01/12	184-04	1
GTO181_LH132x9534-01/12	184-05	0
GTO181_LH132x9534-01/12	184-06	3
GTO181_LH132x9534-01/12	184-07	0
GTO181_LH132x9534-01/12	184-08	0
GTO181_LH132x9534-01/12	184-09	0
GTO181_LH132x9534-04/12	185-01	1
GTO181_LH132x9534-04/12	185-02	0
GTO181_LH132x9534-04/12	185-03	1
GTO181_LH132x9534-04/12	185-04	0
GTO181_LH132x9534-04/12	185-05	0
GTO181_LH132x9534-04/12	185-06	0
GTO181_LH132x9534-04/12	185-07	0
GTO181_LH132x9534-04/12	185-08	3
GTO181_LH132x9534-04/12	185-09	0
GTO181_LH132x9534-06/12	186-01	3
GTO181_LH132x9534-06/12	186-02	0
GTO181_LH132x9534-06/12	186-03	5
GTO181_LH132x9534-06/12	186-04	>50
GTO181_LH132x9534-06/12	186-05	1
GTO181_LH132x9534-06/12	186-06	15
GTO181_LH132x9534-06/12	186-07	5
GTO181_LH132x9534-06/12	186-08	xxx

Table 129. Continued

Description	R13 Row	Top Ear #K
GTO181_LH132x9534-06/12	186-09	0
GTO181_LH132x9534-09/12	187-01	0
GTO181_LH132x9534-09/12	187-02	1
GTO181_LH132x9534-09/12	187-03	0
GTO181_LH132x9534-09/12	187-04a	xxx
GTO181_LH132x9534-09/12	187-04b	xxx
GTO181_LH132x9534-09/12	187-06	10
GTO181_LH132x9534-09/12	187-07	0
GTO181_LH132x9534-09/12	187-08	20
GTO181_LH132x9534-09/12	187-09	>50

9534-5 and 9534-7, the same sources as isolation rows 6097 and 6100 above (Table 124), were crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 130.

Table 130. Results of *gal* nursery evaluation of LH132x9534 F₁ crosses from Guanajuato 181

Description	Top Ear #K
1559-1_LH132xMaizDul-GTO181__9501x9534-05/12	xxx
1559-2_LH132xMaizDul-GTO181__9501x9534-05/12	0
1559-3_LH132xMaizDul-GTO181__9501x9534-05/12	0
1559-4_LH132xMaizDul-GTO181__9501x9534-05/12	10
1559-5_LH132xMaizDul-GTO181__9501x9534-05/12	0
1559-6_LH132xMaizDul-GTO181__9501x9534-05/12	0
1559-7_LH132xMaizDul-GTO181__9501x9534-05/12	0
1559-8_LH132xMaizDul-GTO181__9501x9534-05/12	0
1559-9_LH132xMaizDul-GTO181__9501x9534-05/12	0
1556-1_LH132xMaizDul-GTO181__9501x9534-08/12	0

Table 130. Continued

Description	Top Ear #K
1556-2_LH132xMaizDul-GTO181__9501x9534-08/12	0
1556-3_LH132xMaizDul-GTO181__9501x9534-08/12	0
1556-4_LH132xMaizDul-GTO181__9501x9534-08/12	xxx
1556-5_LH132xMaizDul-GTO181__9501x9534-08/12	0
1556-6_LH132xMaizDul-GTO181__9501x9534-08/12	0
1556-7_LH132xMaizDul-GTO181__9501x9534-08/12	0
1556-8_LH132xMaizDul-GTO181__9501x9534-08/12	0
1556-9_LH132xMaizDul-GTO181__9501x9534-08/12	0

9534-7, the same source as isolation row 6099 above (Table 124), was crossed as male to PHT60, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 131.

Table 131. Results of *gal* nursery evaluation of 9534-7 F₁ crosses from Guanajuato 181

Description	Top Ear #K
1557-1_PHT60xMaizDul-GTO181_S1__9554x9534-07/12	0
1557-2_PHT60xMaizDul-GTO181_S1__9554x9534-07/12	1
1557-3_PHT60xMaizDul-GTO181_S1__9554x9534-07/12	25
1557-4_PHT60xMaizDul-GTO181_S1__9554x9534-07/12	1
1557-5_PHT60xMaizDul-GTO181_S1__9554x9534-07/12	50
1557-6_PHT60xMaizDul-GTO181_S1__9554x9534-07/12	7
1557-7_PHT60xMaizDul-GTO181_S1__9554x9534-07/12	0
1557-8_PHT60xMaizDul-GTO181_S1__9554x9534-07/12	0
1557-9_PHT60xMaizDul-GTO181_S1__9554x9534-07/12	0

F_{2:1}s and BCs

LH132x9533-1, the same material as R13 row 209-9 (Table 125), was crossed as male to NC368 twice, producing BC₁ seed. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 132.

Table 132. Results of *gal* nursery evaluation of 9533-1 BC₁ crosses from Guanajuato 181

Description	Top Ear #K
1525-1_368*2x132.9533-1BC_G181_8598x97-3/13	35
1525-2_368*2x132.9533-1BC_G181_8598x97-3/13	100
1525-3_368*2x132.9533-1BC_G181_8598x97-3/13	xxx
1525-4_368*2x132.9533-1BC_G181_8598x97-3/13	999
1525-5_368*2x132.9533-1BC_G181_8598x97-3/13	250
1525-6_368*2x132.9533-1BC_G181_8598x97-3/13	999
1525-7_368*2x132.9533-1BC_G181_8598x97-3/13	999
1525-8_368*2x132.9533-1BC_G181_8598x97-3/13	999
1525-9_368*2x132.9533-1BC_G181_8598x97-3/13	xxx

LH132x9533-2, the same material as R13 row 261-2 (Table 127), was crossed as male to NC368. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 133.

Table 133. Results of *gal* nursery evaluation of 9533-2 pseudo-BC₁ crosses from Guanajuato 181

Description	Top Ear #K
1526-1_368x195.9533-02_G181_101x261-02/13	999
1526-2_368x195.9533-02_G181_101x261-02/13	999
1526-3_368x195.9533-02_G181_101x261-02/13	999
1526-4_368x195.9533-02_G181_101x261-02/13	35
1526-5_368x195.9533-02_G181_101x261-02/13	999
1526-6_368x195.9533-02_G181_101x261-02/13	999
1526-7_368x195.9533-02_G181_101x261-02/13	999
1526-8_368x195.9533-02_G181_101x261-02/13	0
1526-9_368x195.9533-02_G181_101x261-02/13	xxx

LH132x9533-6, the same material as R13 row 183-4 (Table 125), was crossed as male to NC320. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 134.

Table 134. Results of *gal* nursery evaluation of 9533-6 pseudo-BC₁ crosses from Guanajuato 181

Description	Top Ear #K
1527-1_320x132.9533-06_G181_110x183-04/13	999
1527-2_320x132.9533-06_G181_110x183-04/13	999
1527-3_320x132.9533-06_G181_110x183-04/13	999
1527-4_320x132.9533-06_G181_110x183-04/13	999
1527-5_320x132.9533-06_G181_110x183-04/13	999
1527-6_320x132.9533-06_G181_110x183-04/13	4
1527-7_320x132.9533-06_G181_110x183-04/13	2
1527-8_320x132.9533-06_G181_110x183-04/13	999
1527-9_320x132.9533-06_G181_110x183-04/13	999

NC368x9533-1, the same material as R13 row 206-4 (Table 128), was crossed as male to NC368, producing BC₁ seed. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 134.

Table 135. Results of *gal* nursery evaluation of 9533-9 BC₁ crosses from Guanajuato 181

Description	Top Ear #K
1528-1_368*2x9533-09__G181BCS1_101x206-04/13	999
1528-2_368*2x9533-09__G181BCS1_101x206-04/13	999
1528-3_368*2x9533-09__G181BCS1_101x206-04/13	999
1528-4_368*2x9533-09__G181BCS1_101x206-04/13	999
1528-5_368*2x9533-09__G181BCS1_101x206-04/13	0
1528-6_368*2x9533-09__G181BCS1_101x206-04/13	999
1528-7_368*2x9533-09__G181BCS1_101x206-04/13	999
1528-8_368*2x9533-09__G181BCS1_101x206-04/13	2
1528-9_368*2x9533-09__G181BCS1_101x206-04/13	xxx

NC368x9533-11, the same material as R13 row 207-7 (Table 128), was crossed as male to NC368 twice, producing BC₂ seed. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 136.

Table 136. Results of *gal* nursery evaluation of 9533-11 BC₂ crosses from Guanajuato 181

Description	Top Ear #K
1529-1_368*3x9533-11BC2S1__G181_8594x93-5/13	0
1529-2_368*3x9533-11BC2S1__G181_8594x93-5/13	999
1529-3_368*3x9533-11BC2S1__G181_8594x93-5/13	999
1529-4_368*3x9533-11BC2S1__G181_8594x93-5/13	0

Table 136. Continued

Description	Top Ear #K
1529-5_368*3x9533-11BC2S1__G181_8594x93-5/13	0
1529-6_368*3x9533-11BC2S1__G181_8594x93-5/13	999
1529-7_368*3x9533-11BC2S1__G181_8594x93-5/13	0
1529-8_368*3x9533-11BC2S1__G181_8594x93-5/13	0
1529-9_368*3x9533-11BC2S1__G181_8594x93-5/13	999

LH132x9534-1, the same material as R13 row 184-8 (Table 129), was crossed as male to NC368 twice, producing BC₁ seed. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 137.

Table 137. Results of *gal* nursery evaluation of 9534-1 BC₁ crosses from Guanajuato 181

Description	Top Ear #K
1530-1_368*2x132.9534-1G181BCS1_8571x72-3/13	0
1530-2_368*2x132.9534-1G181BCS1_8571x72-3/13	25
1530-3_368*2x132.9534-1G181BCS1_8571x72-3/13	xxx
1530-4_368*2x132.9534-1G181BCS1_8571x72-3/13	250
1530-5_368*2x132.9534-1G181BCS1_8571x72-3/13	0
1530-6_368*2x132.9534-1G181BCS1_8571x72-3/13	999
1530-7_368*2x132.9534-1G181BCS1_8571x72-3/13	45
1530-8_368*2x132.9534-1G181BCS1_8571x72-3/13	999
1530-9_368*2x132.9534-1G181BCS1_8571x72-3/13	999

LH132x9534-4, the same material as R13 row 185-1 (Table 129), was crossed as male to NC368. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 138.

Table 138. Results of *gal* nursery evaluation of 9534-4 pseudo-BC₁ crosses from Guanajuato 181

Description	Top Ear #K
1560-1_368x132.9534-4S1__GTO181_101x185-1/13	12
1560-2_368x132.9534-4S1__GTO181_101x185-1/13	0
1560-3_368x132.9534-4S1__GTO181_101x185-1/13	999
1560-4_368x132.9534-4S1__GTO181_101x185-1/13	25
1560-5_368x132.9534-4S1__GTO181_101x185-1/13	999
1560-6_368x132.9534-4S1__GTO181_101x185-1/13	999
1560-7_368x132.9534-4S1__GTO181_101x185-1/13	0
1560-8_368x132.9534-4S1__GTO181_101x185-1/13	0
1560-9_368x132.9534-4S1__GTO181_101x185-1/13	xxx

LH132x9534-6, the same material as R13 row 186-9 (Table 129), was crossed as male to NC320, then to PHEG9. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 139.

Table 139. Results of *gal* nursery evaluation of 9534-6 pseudo-BC₂ crosses from Guanajuato 181

Description	Top Ear #K
1558-1_PEG9x20.32/9534-6_0G181_8374x8524-3/13	1
1558-2_PEG9x20.32/9534-6_0G181_8374x8524-3/13	999
1558-3_PEG9x20.32/9534-6_0G181_8374x8524-3/13	999
1558-4_PEG9x20.32/9534-6_0G181_8374x8524-3/13	999
1558-5_PEG9x20.32/9534-6_0G181_8374x8524-3/13	999
1558-6_PEG9x20.32/9534-6_0G181_8374x8524-3/13	999
1558-7_PEG9x20.32/9534-6_0G181_8374x8524-3/13	12
1558-8_PEG9x20.32/9534-6_0G181_8374x8524-3/13	999
1558-9_PEG9x20.32/9534-6_0G181_8374x8524-3/13	0

LH132x9534-9, the same material as R13 row 187-2 (Table 129), was crossed as male to NC368. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 140.

Table 140. Results of *gal* nursery evaluation of 9534-9 pseudo-BC₁ crosses from Guanajuato 181

Description	Top Ear #K
1555-1_368x132.9534-09_G181_101x187-02/13	25
1555-2_368x132.9534-09_G181_101x187-02/13	999
1555-3_368x132.9534-09_G181_101x187-02/13	25
1555-4_368x132.9534-09_G181_101x187-02/13	xxx
1555-5_368x132.9534-09_G181_101x187-02/13	0
1555-6_368x132.9534-09_G181_101x187-02/13	25
1555-7_368x132.9534-09_G181_101x187-02/13	999
1555-8_368x132.9534-09_G181_101x187-02/13	999
1555-9_368x132.9534-09_G181_101x187-02/13	999

Michoacán 412

9536, a row of Michoacán 412, was crossed as male to LH132, planted ear-to-row, and evaluated for resistance to *gal* pollination in an isolation block during summer 2013. Results are presented in Table 141.

Table 141. Results of *gal* isolation block evaluation of 9536 F₁ crosses from Michoacán 412

Description	#K	# Ears For Type	Seg?
6102_LH132xMaizDul-MIC412_9501x9536-02/12	200	8	?

Table 141. Continued

Description	#K	# Ears For Type	Seg?
6103_LH132xMaizDul-MIC412____9501x9536-04/12	0	3	g

9536-2 and 9536-4, the sources of isolation rows 6102 and 6103 above (Table 141), were crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Table 142.

Table 142. Results of *gal* nursery evaluation of LH132x9536 F₁ crosses from Michoacán 412

Description	R13 Row	Top Ear #K
MIC412_LH132x9536-02/12	188-01	>50
MIC412_LH132x9536-02/12	188-02	>50
MIC412_LH132x9536-02/12	188-03	30
MIC412_LH132x9536-02/12	188-04	xxx
MIC412_LH132x9536-02/12	188-05	25
MIC412_LH132x9536-02/12	188-06	15
MIC412_LH132x9536-02/12	188-07	20
MIC412_LH132x9536-02/12	188-08	5
MIC412_LH132x9536-02/12	188-09	20
MIC412_LH132x9536-04/12	189-01	0
MIC412_LH132x9536-04/12	189-02	1
MIC412_LH132x9536-04/12	189-03	0
MIC412_LH132x9536-04/12	189-04	15
MIC412_LH132x9536-04/12	189-05	10
MIC412_LH132x9536-04/12	189-06	xxx
MIC412_LH132x9536-04/12	189-07	xxx
MIC412_LH132x9536-04/12	189-08	10
MIC412_LH132x9536-04/12	189-09	0

9058-1, the first plant in a row of Michoacán 412, was crossed as male to PHZ51, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery.

Results are presented in Table 143.

Table 143. Results of *gal* nursery evaluation of 9058-1 F₁ crosses from Michoacán 412

Description	Top Ear #K
1553-1_PHZ51xMaizDulce-MIC412__9155x9058-1/13	0
1553-2_PHZ51xMaizDulce-MIC412__9155x9058-1/13	2
1553-3_PHZ51xMaizDulce-MIC412__9155x9058-1/13	1
1553-4_PHZ51xMaizDulce-MIC412__9155x9058-1/13	0
1553-5_PHZ51xMaizDulce-MIC412__9155x9058-1/13	0
1553-6_PHZ51xMaizDulce-MIC412__9155x9058-1/13	0
1553-7_PHZ51xMaizDulce-MIC412__9155x9058-1/13	0
1553-8_PHZ51xMaizDulce-MIC412__9155x9058-1/13	1
1553-9_PHZ51xMaizDulce-MIC412__9155x9058-1/13	5

9058-2, the second plant in a row of Michoacán 412, was crossed as male to PHZ51, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery.

Results are presented in Table 144.

Table 144. Results of *gal* nursery evaluation of 9058-2 F₁ crosses from Michoacán 412

Description	Top Ear #K
1552-1_PHZ51xMaizDulce-MIC412__9155x9058-2/13	9
1552-2_PHZ51xMaizDulce-MIC412__9155x9058-2/13	15
1552-3_PHZ51xMaizDulce-MIC412__9155x9058-2/13	xxx
1552-4_PHZ51xMaizDulce-MIC412__9155x9058-2/13	6

Table 144. Continued

Description	Top Ear #K
1552-5_PHZ51xMaizDulce-MIC412__9155x9058-2/13	8
1552-6_PHZ51xMaizDulce-MIC412__9155x9058-2/13	xxx
1552-7_PHZ51xMaizDulce-MIC412__9155x9058-2/13	2
1552-8_PHZ51xMaizDulce-MIC412__9155x9058-2/13	15
1552-9_PHZ51xMaizDulce-MIC412__9155x9058-2/13	6

9059-1, the first plant in a row of Michoacán 412, was crossed as male to PHZ51, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery.

Results are presented in Table 145.

Table 145. Results of *gal* nursery evaluation of 9059-1 F₁ crosses from Michoacán 412

Description	Top Ear #K
1551-1_PHZ51xMaizDulce-MIC412__9155x9059-1/13	xxx
1551-2_PHZ51xMaizDulce-MIC412__9155x9059-1/13	100
1551-3_PHZ51xMaizDulce-MIC412__9155x9059-1/13	75
1551-4_PHZ51xMaizDulce-MIC412__9155x9059-1/13	xxx
1551-5_PHZ51xMaizDulce-MIC412__9155x9059-1/13	xxx
1551-6_PHZ51xMaizDulce-MIC412__9155x9059-1/13	0
1551-7_PHZ51xMaizDulce-MIC412__9155x9059-1/13	1
1551-8_PHZ51xMaizDulce-MIC412__9155x9059-1/13	xxx
1551-9_PHZ51xMaizDulce-MIC412__9155x9059-1/13	100

9059-2, the second plant in a row of Michoacán 412, was crossed as male to PHZ51, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery.

Results are presented in Table 146.

Table 146. Results of *gal* nursery evaluation of 9059-2 F₁ crosses from Michoacán 412

Description	Top Ear #K
1550-1_PHZ51xMaizDulce-MIC412__9155x9059-2/13	0
1550-2_PHZ51xMaizDulce-MIC412__9155x9059-2/13	0
1550-3_PHZ51xMaizDulce-MIC412__9155x9059-2/13	2
1550-4_PHZ51xMaizDulce-MIC412__9155x9059-2/13	0
1550-5_PHZ51xMaizDulce-MIC412__9155x9059-2/13	0
1550-6_PHZ51xMaizDulce-MIC412__9155x9059-2/13	6
1550-7_PHZ51xMaizDulce-MIC412__9155x9059-2/13	2
1550-8_PHZ51xMaizDulce-MIC412__9155x9059-2/13	xxx
1550-9_PHZ51xMaizDulce-MIC412__9155x9059-2/13	15

9059-3, the third plant in a row of Michoacán 412, was crossed as male to PHZ51, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery.

Results are presented in Table 147.

Table 147. Results of *gal* nursery evaluation of 9059-3 F₁ crosses from Michoacán 412

Description	Top Ear #K
1549-1_PHZ51xMaizDulce-MIC412__9155x9059-3/13	8
1549-2_PHZ51xMaizDulce-MIC412__9155x9059-3/13	xxx

Table 147. Continued

Description	Top Ear #K
1549-3_PHZ51xMaizDulce-MIC412__9155x9059-3/13	2
1549-4_PHZ51xMaizDulce-MIC412__9155x9059-3/13	3
1549-5_PHZ51xMaizDulce-MIC412__9155x9059-3/13	0
1549-6_PHZ51xMaizDulce-MIC412__9155x9059-3/13	0
1549-7_PHZ51xMaizDulce-MIC412__9155x9059-3/13	0
1549-8_PHZ51xMaizDulce-MIC412__9155x9059-3/13	2
1549-9_PHZ51xMaizDulce-MIC412__9155x9059-3/13	xxx

9059-4, the fourth plant in a row of Michoacán 412, was crossed as male to PHZ51, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery.

Results are presented in Table 148.

Table 148. Results of *gal* nursery evaluation of 9059-4 F₁ crosses from Michoacán 412

Description	Top Ear #K
1548-1_PHZ51xMaizDulce-MIC412__9155x9059-4/13	0
1548-2_PHZ51xMaizDulce-MIC412__9155x9059-4/13	0
1548-3_PHZ51xMaizDulce-MIC412__9155x9059-4/13	xxx
1548-4_PHZ51xMaizDulce-MIC412__9155x9059-4/13	xxx
1548-5_PHZ51xMaizDulce-MIC412__9155x9059-4/13	0
1548-6_PHZ51xMaizDulce-MIC412__9155x9059-4/13	20
1548-7_PHZ51xMaizDulce-MIC412__9155x9059-4/13	0
1548-8_PHZ51xMaizDulce-MIC412__9155x9059-4/13	0
1548-9_PHZ51xMaizDulce-MIC412__9155x9059-4/13	0

9059-5, the fifth plant in a row of Michoacán 412, was crossed as male to PHZ51, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery.

Results are presented in Table 149.

Table 149. Results of *gal* nursery evaluation of 9059-5 F₁ crosses from Michoacán 412

Description	Top Ear #K
1547-1_PHZ51xMaizDulce-MIC412__9155x9059-5/13	xxx
1547-2_PHZ51xMaizDulce-MIC412__9155x9059-5/13	xxx
1547-3_PHZ51xMaizDulce-MIC412__9155x9059-5/13	0
1547-4_PHZ51xMaizDulce-MIC412__9155x9059-5/13	xxx
1547-5_PHZ51xMaizDulce-MIC412__9155x9059-5/13	0
1547-6_PHZ51xMaizDulce-MIC412__9155x9059-5/13	xxx
1547-7_PHZ51xMaizDulce-MIC412__9155x9059-5/13	0
1547-8_PHZ51xMaizDulce-MIC412__9155x9059-5/13	0
1547-9_PHZ51xMaizDulce-MIC412__9155x9059-5/13	0

9059-6, the sixth plant in a row of Michoacán 412, was crossed as male to PHZ51, planted ear-to-row and evaluated for resistance to *gal* pollination. Results are presented in Table 150.

Table 150. Results of *gal* nursery evaluation of 9059-6 F₁ crosses from Michoacán 412

Description	Top Ear #K
1546-1_PHZ51xMaizDulce-MIC412__9155x9059-6/13	xxx
1546-2_PHZ51xMaizDulce-MIC412__9155x9059-6/13	xxx
1546-3_PHZ51xMaizDulce-MIC412__9155x9059-6/13	xxx
1546-4_PHZ51xMaizDulce-MIC412__9155x9059-6/13	0
1546-5_PHZ51xMaizDulce-MIC412__9155x9059-6/13	20

Table 150. Continued

Description	Top Ear #K
1546-6_PHZ51xMaizDulce-MIC412__9155x9059-6/13	xxx
1546-7_PHZ51xMaizDulce-MIC412__9155x9059-6/13	3

9059-9, the ninth plant in a row of Michoacán 412, was crossed as male to PHZ51, planted ear-to-row and evaluated for resistance to *gal* pollination. Results are presented in Table 151.

Table 151. Results of *gal* nursery evaluation of 9059-9 F₁ crosses from Michoacán 412

Description	Top Ear #K
1545-1_PHZ51xMaizDulce-MIC412__9155x9059-9/13	3
1545-2_PHZ51xMaizDulce-MIC412__9155x9059-9/13	15
1545-3_PHZ51xMaizDulce-MIC412__9155x9059-9/13	xxx
1545-4_PHZ51xMaizDulce-MIC412__9155x9059-9/13	50
1545-5_PHZ51xMaizDulce-MIC412__9155x9059-9/13	xxx
1545-6_PHZ51xMaizDulce-MIC412__9155x9059-9/13	25
1545-7_PHZ51xMaizDulce-MIC412__9155x9059-9/13	100
1545-8_PHZ51xMaizDulce-MIC412__9155x9059-9/13	2
1545-9_PHZ51xMaizDulce-MIC412__9155x9059-9/13	xxx

BC₁s

LH132x9536-4, the same material as R13 row 189-1 (Table 142), was crossed as male to NC320 twice, producing BC₁ seed. Resulting seed was planted ear-to-row and evaluated

for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 152.

Table 152. Results of *gal* nursery evaluation of 9536-4 BC₁ crosses from Michoacán 412

Description	Top Ear #K
1554-1_320*2x132.9536-4_11M412BC_8526x25-6/13	30
1554-2_320*2x132.9536-4_11M412BC_8526x25-6/13	2
1554-3_320*2x132.9536-4_11M412BC_8526x25-6/13	xxx
1554-4_320*2x132.9536-4_11M412BC_8526x25-6/13	0
1554-5_320*2x132.9536-4_11M412BC_8526x25-6/13	xxx
1554-6_320*2x132.9536-4_11M412BC_8526x25-6/13	999
1554-7_320*2x132.9536-4_11M412BC_8526x25-6/13	0
1554-8_320*2x132.9536-4_11M412BC_8526x25-6/13	999
1554-9_320*2x132.9536-4_11M412BC_8526x25-6/13	999

Benz 875 and Benz 878

9521 and 9522, rows of Benz 875, were crossed as male to LH132 (9521-1 to PHT60), planted ear-to-row, and evaluated for resistance to *gal* pollination in an isolation block during summer 2013. Results are presented in Table 153.

Table 153. Results of *gal* isolation block evaluation of 9521 and 9522 F₁ crosses from Benz 875

Description	#K	# Ears For Type	Seg?
6034_PHT60xMaizDul-BENZ875_9554x9521-06/12	58	6	s
6035_LH132xMaizDul-BENZ875_9501x9521-08/12	800	0	n

Table 153. Continued

Description	#K	# Ears For Type	Seg?
6036_LH132xMaizDul-BENZ875__9501x9522-01/12	50	5	s
6037_LH132xMaizDul-BENZ875__9501x9522-02/12	10	1	s
6038_LH132xMaizDul-BENZ875__9501x9522-03/12	50	2	?
6039_LH132xMaizDul-BENZ875__9501x9522-06/12	20	2	?
6040_LH132xMaizDul-BENZ875__9501x9522-07/12	30	5	s
6041_LH132xMaizDul-BENZ875__9501x9522-08/12	999	0	n

9523 and 9524, rows of Benz 875, were crossed as male to LH132 (9524-8 to PHT60, 9524-10 to LH195), planted ear-to-row, and evaluated for resistance to *gal* pollination in an isolation block. Results are presented in Table 154.

Table 154. Results of *gal* isolation block evaluation of 9523 and 9524 F₁ crosses from Benz 878

Description	#K	# Ears For Type	Seg?
6042_LH132xMaizDul-BENZ878__9501x9523-02/12	80	7	s
6043_LH132xMaizDul-BENZ878__9501x9523-08/12	36	3	s
6044_LH132xMaizDul-BENZ878__9501x9523-09/12	120	8	?
6045_LH132xMaizDul-BENZ878__9501x9523-11/12	36	6	?
6046_LH132xMaizDul-BENZ878__9501x9524-04/12	20	2	s
6047_PHT60xMaizDul-BENZ878__9554x9524-08/12	25	7	s
6048_LH195xMaizDul-BENZ878__9506x9524-10/12	6	2	s

9521-5, a source not previously evaluated, was crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Of the three

individual plants evaluated, one set twenty five kernels, and two set more than fifty kernels on the top ear. Results are presented in Appendix I Table 23. 9521-8, the source of isolation row 6036 above (Table 153), was crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination. Results are presented in Table 155.

Table 155. Results of *gal* nursery evaluation of 9521-8 F₁ crosses from Benz 875

Description	R13 Row	Top Ear #K
BNZ8757_NC368x9521-08/12	198-01	30
BNZ8757_NC368x9521-08/12	198-02	>50
BNZ8757_NC368x9521-08/12	198-03	25
BNZ8757_NC368x9521-08/12	198-04	xxx
BNZ8757_NC368x9521-08/12	198-05	30
BNZ8757_NC368x9521-08/12	198-06	xxx
BNZ8757_NC368x9521-08/12	198-07	25
BNZ8757_NC368x9521-08/12	198-08	10
BNZ8757_NC368x9521-08/12	198-09	25

9522-1, 9522-2, 9522-6, 9523-8, 9523-9 and 9523-11, the sources of isolation rows 6036, 6037, 6039 and 6043 through 6045, respectively, above (Table 153), were crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Of the eight individual plants evaluated, five set five or fewer kernels, one set twenty kernels, and one set more than fifty kernels on the top ear. Results are presented in Table 156.

Table 156. Results of *gal* nursery evaluation of LH132x9522 and LH132x9523 F₁ crosses from Benz 875

Description	R13 Row	Top Ear #K
BNZ875_LH132x9522-01/12	122-01	0
BNZ875_LH132x9522-01/12	122-02	5
BNZ875_LH132x9522-01/12	122-03	5
BNZ875_LH132x9522-01/12	122-04	20
BNZ875_LH132x9522-01/12	122-05	0
BNZ875_LH132x9522-01/12	122-06	>50
BNZ875_LH132x9522-01/12	122-07	xxx
BNZ875_LH132x9522-01/12	122-08	2
BNZ875_LH132x9522-02/12	123-05	1
BNZ875_LH132x9522-02/12	123-06	1
BNZ875_LH132x9522-02/12	123-07	1
BNZ875_LH132x9522-02/12	123-08	xxx
BNZ875_LH132x9522-02/12	123-09	1
BNZ875_LH132x9522-06/12	124-06	5
BNZ875_LH132x9522-06/12	124-07	>50
BNZ875_LH132x9522-06/12	124-08	20
BNZ878_LH132x9523-08/12	125-01	>50
BNZ878_LH132x9523-08/12	125-02	0
BNZ878_LH132x9523-08/12	125-03	>50
BNZ878_LH132x9523-08/12	125-04	0
BNZ878_LH132x9523-08/12	125-05	>50
BNZ878_LH132x9523-08/12	125-06	xxx
BNZ878_LH132x9523-08/12	125-07	4
BNZ878_LH132x9523-9/12	126-08	4
BNZ878_LH132x9523-9/12	126-09	3
BNZ878_LH132x9523-11/12	127-01	>50
BNZ878_LH132x9523-11/12	127-02	xxx
BNZ878_LH132x9523-11/12	127-03	10
BNZ878_LH132x9523-11/12	127-04	xxx
BNZ878_LH132x9523-11/12	127-05	0
BNZ878_LH132x9523-11/12	127-06	xxx
BNZ878_LH132x9523-11/12	127-07	xxx
BNZ878_LH132x9523-11/12	127-08	0

Table 156. Continued

Description	R13 Row	Top Ear #K
BNZ878_LH132x9523-11/12	127-09	0

9522-3, the source of isolation row 6038 above (Table 153), was crossed as male to NC368, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Table 157.

Table 157. Results of *gal* nursery evaluation of NC368x9522-3 F₁ crosses from Benz 875

Description	R13 Row	Top Ear #K
BNZ8757_NC368x9522-03/12	199-01	15
BNZ8757_NC368x9522-03/12	199-02	25
BNZ8757_NC368x9522-03/12	199-03	30
BNZ8757_NC368x9522-03/12	199-04	25
BNZ8757_NC368x9522-03/12	199-05	xxx
BNZ8757_NC368x9522-03/12	199-06	>50
BNZ8757_NC368x9522-03/12	199-07	25
BNZ8757_NC368x9522-03/12	199-08	>50
BNZ8757_NC368x9522-03/12	199-09	>50

9522-3 was also crossed as male to LH132 planted ear-to-row and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Appendix I Table 24.

Pseudo-BC₁s

LH132x9522-2, the same material as R13 row 123-9 (Table 156), was crossed as male to NC320. Resulting seed was planted ear-to-row and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Table 158.

Table 158. Results of *gal* nursery evaluation of 9522-2 pseudo-BC₁ crosses from Benz 875

Description	Top Ear #K
672-1_320x132.9522-2BZ875_110x123-09/13	0
672-2_320x132.9522-2BZ875_110x123-09/13	500
672-3_320x132.9522-2BZ875_110x123-09/13	0
672-4_320x132.9522-2BZ875_110x123-09/13	500
672-5_320x132.9522-2BZ875_110x123-09/13	0
672-6_320x132.9522-2BZ875_110x123-09/13	500
672-7_320x132.9522-2BZ875_110x123-09/13	450
672-8_320x132.9522-2BZ875_110x123-09/13	2
672-9_320x132.9522-2BZ875_110x123-09/13	40

Z07-011

9528, a row of Z07-011, was crossed as male to synchronously flowering lines, seed of which was planted ear-to-row and evaluated for resistance to *gal* pollination in the 2013 summer nursery. 9528-2, the second plant in the row, was crossed to LH51. Results are presented in Table 159.

Table 159. Results of *gal* nursery evaluation of LH51x9528-2 F₁ crosses from Z07-011

Description	R13 Row	Top Ear #K
Z07011_LH51x9528-02/12	79-01	>50
Z07011_LH51x9528-02/12	79-02	xxx
Z07011_LH51x9528-02/12	79-03	10
Z07011_LH51x9528-02/12	79-04	xxx
Z07011_LH51x9528-02/12	79-05	xxx
Z07011_LH51x9528-02/12	79-06	>50
Z07011_LH51x9528-02/12	79-07	xxx
Z07011_LH51x9528-02/12	79-08	3
Z07011_LH51x9528-02/12	79-09	>50

9528-2 was also crossed to LH132, seed of which was planted ear-to-row and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Table 160.

Table 160. Results of *gal* nursery evaluation of LH132x9528-2 F₁ crosses from Z07-011

Description	R13 Row	Top Ear #K
Z07011_LH132x9528-02/12	132-01	0
Z07011_LH132x9528-02/12	132-02	1
Z07011_LH132x9528-02/12	132-03	5
Z07011_LH132x9528-02/12	132-04	0
Z07011_LH132x9528-02/12	132-05	1
Z07011_LH132x9528-02/12	132-06	0
Z07011_LH132x9528-02/12	132-07	2
Z07011_LH132x9528-02/12	132-08	0
Z07011_LH132x9528-02/12	132-09	0

9528-4 was crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Table 161.

Table 161. Results of *gal* nursery evaluation of 9528-4 F₁ crosses from Z07-011

Description	R13 Row	Top Ear #K
Z07011_LH132x9528-04/12	133-01	>50
Z07011_LH132x9528-04/12	133-02	0
Z07011_LH132x9528-04/12	133-03	1
Z07011_LH132x9528-04/12	133-04	>50
Z07011_LH132x9528-04/12	133-05	0
Z07011_LH132x9528-04/12	133-06	xxx
Z07011_LH132x9528-04/12	133-07	1
Z07011_LH132x9528-04/12	133-08	>50
Z07011_LH132x9528-04/12	133-09	20

9528-5 was crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Table 162.

Table 162. Results of *gal* nursery evaluation of LH132x9528-5 F₁ crosses from Z07-011

Description	R13 Row	Top Ear #K
Z07011_LH132x9528-05/12	134-01	1
Z07011_LH132x9528-05/12	134-02	30
Z07011_LH132x9528-05/12	134-03	>50
Z07011_LH132x9528-05/12	134-04	xxx
Z07011_LH132x9528-05/12	134-05	0
Z07011_LH132x9528-05/12	134-06	0
Z07011_LH132x9528-05/12	134-07	0

Table 162. Continued

Description	R13 Row	Top Ear #K
Z07011_LH132x9528-05/12	134-08	>50
Z07011_LH132x9528-05/12	134-09	0

9528-2 was also crossed to LH51, seed of which was planted ear-to-row and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Table 163.

Table 163. Results of *gal* nursery evaluation of LH51x9528-5 F₁ crosses from Z07-011

Description	R13 Row	Top Ear #K
Z07011_LH51x9528-05/12	80-01	25
Z07011_LH51x9528-05/12	80-02	5
Z07011_LH51x9528-05/12	80-03	>50
Z07011_LH51x9528-05/12	80-04	>50
Z07011_LH51x9528-05/12	80-05	>50
Z07011_LH51x9528-05/12	80-06	25
Z07011_LH51x9528-05/12	80-07	25
Z07011_LH51x9528-05/12	80-08	2
Z07011_LH51x9528-05/12	80-09	>50

9528-6 was crossed as male to LH132, planted ear-to-row and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Table 164.

Table 164. Results of *gal* nursery evaluation of 9528-6 F₁ crosses from Z07-011

Description	R13 Row	Top Ear #K
Z07011_LH132x9528-06/12	135-01	>50
Z07011_LH132x9528-06/12	135-02	1
Z07011_LH132x9528-06/12	135-03	0
Z07011_LH132x9528-06/12	135-04	1
Z07011_LH132x9528-06/12	135-05	>50
Z07011_LH132x9528-06/12	135-06	>50
Z07011_LH132x9528-06/12	135-07	>50
Z07011_LH132x9528-06/12	135-08	20
Z07011_LH132x9528-06/12	135-09	20

Palomero Tipo de Chihuahua 148

9528, a row of CHH 148, was crossed as male to PHB47, seed of which was planted ear-to-row and evaluated for resistance to *gal* pollination in an isolation block during summer 2013. Results are presented in Table 165.

Table 165. Results of *gal* isolation block evaluation of 9541 F₁ crosses from Palomero-CHH 148

Description	#K	# Ears For Type	Seg?
6007_(B47/Pal_Ch-CHH_148)-1____9540x9541-1/10	500	0	n
6008_(B47/Pal_Ch-CHH_148)-2____9540x9541-2/10	32	5	s
6009_(B47/Pal_Ch-CHH_148)-3____9540x9541-3/10	90	7	s
6010_(B47/Pal_Ch-CHH_148)-4____9540x9541-4/10	999	0	n
6011_(B47/Pal_Ch-CHH_148)-5____9540x9541-5/10	8	1	s
6012_(B47/Pal_Ch-CHH_148)-6____9540x9541-6/10	400	0	n
6013_(B47/Pal_Ch-CHH_148)-7____9540x9541-7/10	42	1	n

Table 165. Continued

Description	#K	# Ears For Type	Seg?
6014_(B47/Pal_Ch-CHH_148)-8_9540x9541-8/10	2	1	s
6015_(B47/Pal_Ch-CHH_148)-9_9540x9541-9/10	40	5	s

9541, a row of CHH 148, was crossed as male to PHB47, seed of which was planted ear-to-row and evaluated for resistance to *gal* pollination in the 2014 summer nursery. Results are presented in Table 166.

Table 166. Results of *gal* nursery evaluation of 9541-h F₁ crosses from Palomero-CHH 148

Description	Top Ear #K
1574-1_(B47/Pal_Ch-CHH_148)-8_9521x9541-h/10	0
1574-2_(B47/Pal_Ch-CHH_148)-8_9521x9541-h/10	0
1574-3_(B47/Pal_Ch-CHH_148)-8_9521x9541-h/10	0
1574-4_(B47/Pal_Ch-CHH_148)-8_9521x9541-h/10	1
1574-5_(B47/Pal_Ch-CHH_148)-8_9521x9541-h/10	1
1574-6_(B47/Pal_Ch-CHH_148)-8_9521x9541-h/10	1
1574-7_(B47/Pal_Ch-CHH_148)-8_9521x9541-h/10	10
1574-8_(B47/Pal_Ch-CHH_148)-8_9521x9541-h/10	0
1574-9_(B47/Pal_Ch-CHH_148)-8_9521x9541-h/10	0

9541, a row of CHH 148, was crossed as male to PHB47, seed of which were planted ear-to-row and selfed. Seed from four plants in one such row, 3809, were planted ear-to-row and evaluated for resistance to *gal* pollination in an isolation block during summer 2013. 3809

does not directly derive from the above tested row, instead coming from a bulk of the same cross. Results are presented in Table 167.

Table 167. Results of *gal* isolation evaluation of 9541 F₂ families from Palomero-CHH 148

Description	#K on Row	# Ears Obs.	Seg?
6691_B47/Pal_Ch_CHH_148_B_F2_3809-1/12	15	8	n
6692_B47/Pal_Ch_CHH_148_B_F2_3809-2/12	50	8	y
6693_B47/Pal_Ch_CHH_148_B_F2_3809-3/12	300	8	y
6694_B47/Pal_Ch_CHH_148_B_F2_3809-4/1	0	8	n

Seed from 3809-1 (Table 167) was also planted ear-to-row in the nursery and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Table 168.

Table 168. Results of *gal* nursery evaluation of 9541(3809-1) F₂ families from Palomero-CHH 148

Description	R13 Row	Top Ear #K
B47/Pal_Ch_CHH148_B_F2_3809-1/12	559-01	0
B47/Pal_Ch_CHH148_B_F2_3809-1/12	559-02	1
B47/Pal_Ch_CHH148_B_F2_3809-1/12	559-03	40
B47/Pal_Ch_CHH148_B_F2_3809-1/12	559-04	xxx
B47/Pal_Ch_CHH148_B_F2_3809-1/12	559-05	0
B47/Pal_Ch_CHH148_B_F2_3809-1/12	559-06	xxx

Seed from 3809-2 (Table 167), the second plant in the F₁ row, was planted ear-to-row in the nursery and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Table 169.

Table 169. Results of *gal* nursery evaluation of 9541(3809-2) F₂ lines from Palomero-CHH 148

Description		R13 Row	Top Ear #K
B47/Pal_Ch_CHH_148_B_F2	3809-2/12	562-01	0
B47/Pal_Ch_CHH_148_B_F2	3809-2/12	562-02	0
B47/Pal_Ch_CHH_148_B_F2	3809-2/12	562-03	0
B47/Pal_Ch_CHH_148_B_F2	3809-2/12	562-04a	xxx
B47/Pal_Ch_CHH_148_B_F2	3809-2/12	562-04b	100
B47/Pal_Ch_CHH_148_B_F2	3809-2/12	562-05	0
B47/Pal_Ch_CHH_148_B_F2	3809-2/12	562-06	1
B47/Pal_Ch_CHH_148_B_F2	3809-2/12	562-07	0

Seed from 3809-3 (Table 167), the third plant in the F₁ row, was planted ear-to-row in the nursery and evaluated for resistance to *gal* pollination in the 2013 summer nursery. Results are presented in Table 170.

Table 170. Results of *gal* nursery evaluation of 9541(3809-3) F₂ lines from Palomero-CHH 148

Description		R13 Row	Top Ear #K
B47/Pal_Ch_CHH_148_B_F2	3809-3/12	565-01	0
B47/Pal_Ch_CHH_148_B_F2	3809-3/12	565-02	xxx
B47/Pal_Ch_CHH_148_B_F2	3809-3/12	565-03a	80

***Tcb1* Backcrossing**

Lines homozygous for *Tcb1* and *Gal-m* were crossed and backcrossed into various lines to examine the effectiveness of the barriers in backcrossing into adapted lines.

Homozygous *Tcb1+Gal-m/Tcb1+Gal-m* lines were crossed and backcrossed into standard lines and evaluated for maintained resistance to *gal* pollination during each generation of backcrossing. Lines were crossed and backcrossed to NC464 to produce BC₁ seed, which was evaluated for resistance to *Gal-s* pollen in summer nursery 2014. Of nine ears evaluated, one set zero kernels, one set one kernel, and the remaining seven ranged in set from forty to 200 kernels per ear, with an overall average of 90.1 kernels per ear. Results are presented in Table 172.

Table 172. Results of *Gal-s* nursery evaluation of *Tcb1+Gal-m* BC₁s with NC464

Description	Top Ear #K
997-1 <u>NC464*2xTcb1+Gal-M_BC</u> 8065x66-bk6/11	90
997-2 <u>NC464*2xTcb1+Gal-M_BC</u> 8065x66-bk6/11	200
997-3 <u>NC464*2xTcb1+Gal-M_BC</u> 8065x66-bk6/11	90
997-4 <u>NC464*2xTcb1+Gal-M_BC</u> 8065x66-bk6/11	90
997-5 <u>NC464*2xTcb1+Gal-M_BC</u> 8065x66-bk6/11	150
997-6 <u>NC464*2xTcb1+Gal-M_BC</u> 8065x66-bk6/11	150
997-7 <u>NC464*2xTcb1+Gal-M_BC</u> 8065x66-bk6/11	40
997-8 <u>NC464*2xTcb1+Gal-M_BC</u> 8065x66-bk6/11	1
997-9 <u>NC464*2xTcb1+Gal-M_BC</u> 8065x66-bk6/11	0

Evaluation of an identical backcross showed similar results. The nine ears evaluated ranged in set from a single kernel to 600 kernels on the ear, with an average of 315.7 kernels per ear.

Results are presented in Table 173.

Table 173. Results of additional *Gal-s* nursery evaluation of *Tcb1+Gal-m* BC₁s with NC464

Description	Top Ear #K
1000-1 NC464*2xTcb1+Ga1-M_BC 8068x67-bk4/11	500
1000-2 NC464*2xTcb1+Ga1-M_BC 8068x67-bk4/11	500
1000-3 NC464*2xTcb1+Ga1-M_BC 8068x67-bk4/11	40
1000-4 NC464*2xTcb1+Ga1-M_BC 8068x67-bk4/11	1
1000-5 NC464*2xTcb1+Ga1-M_BC 8068x67-bk4/11	50
1000-6 NC464*2xTcb1+Ga1-M_BC 8068x67-bk4/11	600
1000-7 NC464*2xTcb1+Ga1-M_BC 8068x67-bk4/11	300
1000-8 NC464*2xTcb1+Ga1-M_BC 8068x67-bk4/11	500
1000-9 NC464*2xTcb1+Ga1-M_BC 8068x67-bk4/11	350

Crossing and backcrossing to NC520 resulted in six ears ranging in set from a single kernel to 900 kernels on each ear when evaluated, with an average of 373.5 kernels per ear. Results are presented in Table 174.

Table 174. Results of *Gal-s* nursery evaluation of *Tcb1+Gal-m* BC₁s with NC520

Description	Top Ear #K
1419-1 NC520*2xTcb1+Ga1-M_BC 8077x78-bk6/11	xxx
1419-2 NC520*2xTcb1+Ga1-M_BC 8077x78-bk6/11	250

Table 174. Continued

Description	Top Ear #K
1419-3 _NC520*2xTcb1+Gal-M_BC__ 8077x78-bk6/11	900
1419-4 _NC520*2xTcb1+Gal-M_BC__ 8077x78-bk6/11	1
1419-5 _NC520*2xTcb1+Gal-M_BC__ 8077x78-bk6/11	xxx
1419-6 _NC520*2xTcb1+Gal-M_BC__ 8077x78-bk6/11	200
1419-7 _NC520*2xTcb1+Gal-M_BC__ 8077x78-bk6/11	800
1419-8 _NC520*2xTcb1+Gal-M_BC__ 8077x78-bk6/11	90
1419-9 _NC520*2xTcb1+Gal-M_BC__ 8077x78-bk6/11	xxx

Crossing and backcrossing to 1116-1 resulted in five ears setting zero kernels, and the remaining three setting one or two kernels when evaluated, for an overall average of 0.6 kernels per ear. Results are presented in Table 175.

Table 175. Results of *gal* nursery evaluation of *Tcb1+Gal-m* BC₁s with 1116-1

Description	Top Ear #K
1422-1 _1116-1*2xTcb+MF2_BC_356-7_8049x50-a/11	0
1422-2 _1116-1*2xTcb+MF2_BC_356-7_8049x50-a/11	xxx
1422-3 _1116-1*2xTcb+MF2_BC_356-7_8049x50-a/11	0
1422-4 _1116-1*2xTcb+MF2_BC_356-7_8049x50-a/11	0
1422-5 _1116-1*2xTcb+MF2_BC_356-7_8049x50-a/11	1
1422-6 _1116-1*2xTcb+MF2_BC_356-7_8049x50-a/11	2
1422-7 _1116-1*2xTcb+MF2_BC_356-7_8049x50-a/11	0
1422-8 _1116-1*2xTcb+MF2_BC_356-7_8049x50-a/11	2
1422-9 _1116-1*2xTcb+MF2_BC_356-7_8049x50-a/11	0

Backcrossing to 8213-2 once resulted in two ears setting zero kernels and seven ears ranging in set from six kernels to 400 kernels on the row, with an overall average of 145.1 kernels per ear. Results are presented in Table 176.

Table 176. Results of *gal* nursery evaluation of *Tcb1+Gal-m* BC₁s with 8213-2

Description	Top Ear #K
628-1_8213-2*2xTcb1_3_8466x65-1/13	400
628-2_8213-2*2xTcb1_3_8466x65-1/13	0
628-3_8213-2*2xTcb1_3_8466x65-1/13	250
628-4_8213-2*2xTcb1_3_8466x65-1/13	6
628-5_8213-2*2xTcb1_3_8466x65-1/13	250
628-6_8213-2*2xTcb1_3_8466x65-1/13	100
628-7_8213-2*2xTcb1_3_8466x65-1/13	0
628-8_8213-2*2xTcb1_3_8466x65-1/13	150
628-9_8213-2*2xTcb1_3_8466x65-1/13	150

Evaluation of seed derived from the neighboring F₁ plant showed very different results, with six ears setting zero kernels, one setting thirteen kernels, and one setting sixty-five kernels, for an overall average of 9.8 kernels per ear. Results are presented in Table 177.

Table 177. Results of additional *gal* nursery evaluation of *Tcb1+Gal-m* BC₁s with 8213-2

Description	Top Ear #K
629-1_8213-2*2xTcb1_3_8466x65-3/13	0
629-2_8213-2*2xTcb1_3_8466x65-3/13	0
629-3_8213-2*2xTcb1_3_8466x65-3/13	xxx
629-4_8213-2*2xTcb1_3_8466x65-3/13	0

Table 177. Continued

Description	Top Ear #K
629-5_8213-2*2xTcb1_3_8466x65-3/13	0
629-6_8213-2*2xTcb1_3_8466x65-3/13	13
629-7_8213-2*2xTcb1_3_8466x65-3/13	0
629-8_8213-2*2xTcb1_3_8466x65-3/13	0
629-9_8213-2*2xTcb1_3_8466x65-3/13	65

Backcrossing to HBA1 three times resulted in seed set ranging from zero to nineteen kernels set on nine individual plants, with an average of 7.2 kernels per ear. Results are presented in Table 178.

Table 178. Results of *gal* nursery evaluation of *Tcb1+Gal-m* BC₃S with HBA1

Description	Top Ear #K
601-1_HBA1*4xTcb1_359-10_8419x20-3/13	3
601-2_HBA1*4xTcb1_359-10_8419x20-3/13	3
601-3_HBA1*4xTcb1_359-10_8419x20-3/13	15
601-4_HBA1*4xTcb1_359-10_8419x20-3/13	0
601-5_HBA1*4xTcb1_359-10_8419x20-3/13	8
601-6_HBA1*4xTcb1_359-10_8419x20-3/13	6
601-7_HBA1*4xTcb1_359-10_8419x20-3/13	0
601-8_HBA1*4xTcb1_359-10_8419x20-3/13	11
601-9_HBA1*4xTcb1_359-10_8419x20-3/13	19

Evaluating seed from another plant within the BC₂ row, seed set ranged from zero to fifty five kernels, with an average of 8.1 kernels per ear. Results are presented in Table 179.

Table 179. Results of additional *gal* nursery evaluation of *Tcb1+Gal-m* (8420-5) BC₃s with HBA1

Description	Top Ear #K
604-1_HBA1*4xTcb1_359-10_____8419x20-5/13	55
604-2_HBA1*4xTcb1_359-10_____8419x20-5/13	0
604-3_HBA1*4xTcb1_359-10_____8419x20-5/13	0
604-4_HBA1*4xTcb1_359-10_____8419x20-5/13	4
604-5_HBA1*4xTcb1_359-10_____8419x20-5/13	0
604-6_HBA1*4xTcb1_359-10_____8419x20-5/13	0
604-7_HBA1*4xTcb1_359-10_____8419x20-5/13	12
604-8_HBA1*4xTcb1_359-10_____8419x20-5/13	0
604-9_HBA1*4xTcb1_359-10_____8419x20-5/13	2

Backcrossing to NC368 three times resulted in seed set ranging from thirty-five kernels to 600 kernels on the row, with an average of 409.4 kernels per ear set. Results are presented in Table 180.

Table 180. Results of *gal* nursery evaluation of *Tcb1+Gal-m* (8436-2) BC₃s with HBA1

Description	Top Ear #K
613-1_NC368*4xTcb1+Gal-M_____8435x36-2/13	500
613-2_NC368*4xTcb1+Gal-M_____8435x36-2/13	500
613-3_NC368*4xTcb1+Gal-M_____8435x36-2/13	500
613-4_NC368*4xTcb1+Gal-M_____8435x36-2/13	400
613-5_NC368*4xTcb1+Gal-M_____8435x36-2/13	500
613-6_NC368*4xTcb1+Gal-M_____8435x36-2/13	35
613-7_NC368*4xTcb1+Gal-M_____8435x36-2/13	50
613-8_NC368*4xTcb1+Gal-M_____8435x36-2/13	600
613-9_NC368*4xTcb1+Gal-M_____8435x36-2/13	600

Evaluation of seed derived from the neighboring BC₂ plant showed very different results, with five ears setting zero kernels, and five ranging in set from eighty to 250 kernels, for an overall average of 88 kernels per row. Results are presented in Table 181.

Table 181. Results of additional *gal* nursery evaluation of *Tcb1+Gal-m* (8436-3) BC₃s with NC368

Description		Top Ear #K
616-1	NC368*4xTcb1+Gal-M 8435x36-3/13	0
616-2	NC368*4xTcb1+Gal-M 8435x36-3/13	200
616-3	NC368*4xTcb1+Gal-M 8435x36-3/13	0
616-4	NC368*4xTcb1+Gal-M 8435x36-3/13	80
616-5	NC368*4xTcb1+Gal-M 8435x36-3/13	250
616-6	NC368*4xTcb1+Gal-M 8435x36-3/13	100
616-7	NC368*4xTcb1+Gal-M 8435x36-3/13	0
616-7	NC368*4xTcb1+Gal-M 8435x36-3/13	0
616-8	NC368*4xTcb1+Gal-M 8435x36-3/13	0
616-9	NC368*4xTcb1+Gal-M 8435x36-3/13	250

After three generations of backcrossing to NC474, evaluation resulted in all eight ears evaluated setting zero kernels. Results are presented in Table 182.

Table 182. Results of *gal* nursery evaluation of *Tcb1+Gal-m* (8445-2) BC₃s with NC474

Description		Top Ear #K
621-1	NC474*4xTcb1+Gal-M 8446x45-2/13	0
621-2	NC474*4xTcb1+Gal-M 8446x45-2/13	0
621-3	NC474*4xTcb1+Gal-M 8446x45-2/13	0
621-4	NC474*4xTcb1+Gal-M 8446x45-2/13	0

Table 182. Continued

Description		Top Ear #K
621-5	<u>NC474*4xTcb1+Gal-M</u> 8446x45-2/13	0
621-6	<u>NC474*4xTcb1+Gal-M</u> 8446x45-2/13	0
621-7	<u>NC474*4xTcb1+Gal-M</u> 8446x45-2/13	0
621-8	<u>NC474*4xTcb1+Gal-M</u> 8446x45-2/13	0
621-9	<u>NC474*4xTcb1+Gal-M</u> 8446x45-2/13	xxx

Evaluation of seed derived from the neighboring BC₂ plant showed similar results, with eight setting zero kernels and one setting five kernels on the top ear, for an average of 0.6 kernels per ear. Results are presented in Table 183.

Table 183. Results of additional *gal* nursery evaluation of *Tcb1+Gal-m* (8445-5) BC₃s with NC474

Description		Top Ear #K
624-1	<u>NC474*4xTcb1+Gal-M</u> 8446x45-5/13	0
624-2	<u>NC474*4xTcb1+Gal-M</u> 8446x45-5/13	0
624-3	<u>NC474*4xTcb1+Gal-M</u> 8446x45-5/13	5
624-4	<u>NC474*4xTcb1+Gal-M</u> 8446x45-5/13	xxx
624-5	<u>NC474*4xTcb1+Gal-M</u> 8446x45-5/13	0
624-6	<u>NC474*4xTcb1+Gal-M</u> 8446x45-5/13	0
624-6	<u>NC474*4xTcb1+Gal-M</u> 8446x45-5/13	0
624-7	<u>NC474*4xTcb1+Gal-M</u> 8446x45-5/13	0
624-8	<u>NC474*4xTcb1+Gal-M</u> 8446x45-5/13	0
624-9	<u>NC474*4xTcb1+Gal-M</u> 8446x45-5/13	0

After three generations of backcrossing to NC508, evaluation resulted in eight ears ranging in set from forty to 300 kernels per ear, with an average of 194.4 kernels per ear. Results are presented in Table 184.

Table 184. Results of *gal* nursery evaluation of *Tcb1+Gal-m* (8452-5) BC₃s with NC508

Description		Top Ear #K
625-1	NC508*4xTcb-1 8451x52-5/13	300
625-2	NC508*4xTcb-1 8451x52-5/13	40
625-3	NC508*4xTcb-1 8451x52-5/13	300
625-4	NC508*4xTcb-1 8451x52-5/13	300
625-5	NC508*4xTcb-1 8451x52-5/13	150
625-6	NC508*4xTcb-1 8451x52-5/13	150
625-7	NC508*4xTcb-1 8451x52-5/13	250
625-8	NC508*4xTcb-1 8451x52-5/13	65
625-9	NC508*4xTcb-1 8451x52-5/13	xxx

After four generations of backcrossing to NC400, evaluation in summer nursery 2014 resulted in seven ears setting zero kernels, one setting 75 kernels, and one setting 100 kernels, for an overall average of 19.4 kernels per ear. Results are presented in Table 185.

Table 185. Results of *Gal-s* nursery evaluation of *Tcb1+Gal-m* (8437-2) BC₄s with NC400

Description		Top Ear #K
617-1	NC400*5xTcb1+M 8438x37-2/13	0
617-2	NC400*5xTcb1+M 8438x37-2/13	0
617-3	NC400*5xTcb1+M 8438x37-2/13	0

Table 185. Continued

Description		Top Ear #K
617-4	NC400*5xTcb1+M 8438x37-2/13	0
617-5	NC400*5xTcb1+M 8438x37-2/13	0
617-6	NC400*5xTcb1+M 8438x37-2/13	0
617-7	NC400*5xTcb1+M 8438x37-2/13	100
617-8	NC400*5xTcb1+M 8438x37-2/13	0
617-9	NC400*5xTcb1+M 8438x37-2/13	75

Evaluation of seed derived from the neighboring BC₃ plant showed similar results, with eight setting zero kernels and one setting 250 kernels on the top ear, for an average of 27.8 kernels per ear. Results are presented in Table 186.

Table 186. Results of additional *Gal-s* nursery evaluation of *Tcb1+Gal-m* (8437-3) BC_{4s} with NC400

Description		Top Ear #K
620-1	NC400*5xTcb1+M 8438x37-3/13	0
620-2	NC400*5xTcb1+M 8438x37-3/13	0
620-3	NC400*5xTcb1+M 8438x37-3/13	0
620-4	NC400*5xTcb1+M 8438x37-3/13	0
620-5	NC400*5xTcb1+M 8438x37-3/13	0
620-6	NC400*5xTcb1+M 8438x37-3/13	0
620-7	NC400*5xTcb1+M 8438x37-3/13	0
620-8	NC400*5xTcb1+M 8438x37-3/13	250
620-9	NC400*5xTcb1+M 8438x37-3/13	0

After five generations of backcrossing into NC354, seed was planted ear-to-row in nursery and evaluated for resistance to *gal* pollen. Eight of nine ears set zero kernels, and one ear set 250 kernels. Results are presented in Table 187.

Table 187. Results of *Gal-s* nursery evaluation of *Tcb1+Gal-m* (8437-3) BC₅s with NC354

Description	Top Ear #K
609-1 _NC354*6xTcbM_357-6_w_____8430x29-5/13	0
609-2 _NC354*6xTcbM_357-6_w_____8430x29-5/13	0
609-3 _NC354*6xTcbM_357-6_w_____8430x29-5/13	0
609-4 _NC354*6xTcbM_357-6_w_____8430x29-5/13	0
609-5 _NC354*6xTcbM_357-6_w_____8430x29-5/13	0
609-6 _NC354*6xTcbM_357-6_w_____8430x29-5/13	0
609-7 _NC354*6xTcbM_357-6_w_____8430x29-5/13	0
609-8 _NC354*6xTcbM_357-6_w_____8430x29-5/13	250
609-9 _NC354*6xTcbM_357-6_w_____8430x29-5/13	0

Evaluation of seed derived from another plant in the BC₄ row advanced to BC₅ showed similar results, with all ten ears evaluated setting zero kernels. Results are presented in Table 188.

Table 188. Results of *Gal-s* nursery evaluation of *Tcb1+Gal-m* (8432-2) BC₅s with NC354

Description	Top Ear #K
612-1 _NC354*6xTcbM_357-9_____8431x32-2/13	0
612-1 _NC354*6xTcbM_357-9_____8431x32-2/13	0
612-2 _NC354*6xTcbM_357-9_____8431x32-2/13	0
612-2 _NC354*6xTcbM_357-9_____8431x32-2/13	0

Table 188. Continued

Description	Top Ear #K
612-3_NC354*6xTcbM_357-9_8431x32-2/13	0
612-4_NC354*6xTcbM_357-9_8431x32-2/13	0
612-5_NC354*6xTcbM_357-9_8431x32-2/13	0
612-6_NC354*6xTcbM_357-9_8431x32-2/13	0
612-7_NC354*6xTcbM_357-9_8431x32-2/13	0
612-8_NC354*6xTcbM_357-9_8431x32-2/13	0
612-9_NC354*6xTcbM_357-9_8431x32-2/13	xxx

After five generations of backcrossing into P4639-1, seed was planted ear-to-row in nursery and evaluated for resistance to “normal” pollen in summer nursery 2014. All nine ears evaluated set zero kernels on the top ear. Results are presented in Table 189.

Table 189. Results of *Gal-s* nursery evaluation of *Tcb1+Galm* (8468-1) BC₅S with P4639-1

Description	Top Ear #K
632-1_P4639-1*6xTcb_517-1_8467x68-1/13	0
632-2_P4639-1*6xTcb_517-1_8467x68-1/13	0
632-3_P4639-1*6xTcb_517-1_8467x68-1/13	0
632-4_P4639-1*6xTcb_517-1_8467x68-1/13	0
632-5_P4639-1*6xTcb_517-1_8467x68-1/13	0
632-6_P4639-1*6xTcb_517-1_8467x68-1/13	0
632-7_P4639-1*6xTcb_517-1_8467x68-1/13	0
632-8_P4639-1*6xTcb_517-1_8467x68-1/13	0
632-9_P4639-1*6xTcb_517-1_8467x68-1/13	0

Evaluation of seed derived from the neighboring BC₄ plant showed similar results, with six of eight setting zero kernels, however, one set 150 kernels and one set 200 kernels, for an average of 43.8 kernels per ear. Results are presented in Table 190.

Table 190. Results of *Gal-s* nursery evaluation of *Tcb1+Gal-m* (8468-2) BC₅s with P4639-1

Description	Top Ear #K
633-1_P4639-1*6xTcb_517-1_____8467x68-2/13	0
633-2_P4639-1*6xTcb_517-1_____8467x68-2/13	xxx
633-3_P4639-1*6xTcb_517-1_____8467x68-2/13	0
633-4_P4639-1*6xTcb_517-1_____8467x68-2/13	0
633-5_P4639-1*6xTcb_517-1_____8467x68-2/13	0
633-6_P4639-1*6xTcb_517-1_____8467x68-2/13	0
633-7_P4639-1*6xTcb_517-1_____8467x68-2/13	150
633-8_P4639-1*6xTcb_517-1_____8467x68-2/13	200
633-9_P4639-1*6xTcb_517-1_____8467x68-2/13	0

After five generations of backcrossing into NC296, a line homozygous for *Gal-s*, seed was planted ear-to-row in nursery and evaluated for resistance to *Gal-s* pollen in summer nursery 2014. Three ears set zero kernels, and five ranged in set from twenty to 200 kernels on the top ear, for an overall average of 77.5 kernels per ear. Results are presented in Table 191.

Table 191. Results of *Gal-s* nursery evaluation of *Tcb1+Gal-m* (8421-2) BC₅s with NC296

Description	Top Ear #K
605-1_NC296*6xTcb1+MB_w_____8422x21-2/13	20

Table 191. Continued

Description		Top Ear #K
605-2	NC296*6xTcb1+MB_w_8422x21-2/13	0
605-3	NC296*6xTcb1+MB_w_8422x21-2/13	200
605-4	NC296*6xTcb1+MB_w_8422x21-2/13	150
605-5	NC296*6xTcb1+MB_w_8422x21-2/13	0
605-6	NC296*6xTcb1+MB_w_8422x21-2/13	xxx
605-7	NC296*6xTcb1+MB_w_8422x21-2/13	200
605-8	NC296*6xTcb1+MB_w_8422x21-2/13	0
605-9	NC296*6xTcb1+MB_w_8422x21-2/13	50

Evaluation of seed derived from the neighboring BC₄ plant showed similar results, with five of seven ears setting zero kernels, one setting 42 kernels and one setting 55 kernels, for an average of 13.9 kernels per ear. Results are presented in Table 192.

Table 192. Results of additional *Gal-s* nursery evaluation of *Tcb1+Gal-m* (8421-3) BC₅s with NC296

Description		Top Ear #K
608-1	NC296*6xTcb1+MB_w_003_8422x21-3/13	0
608-2	NC296*6xTcb1+MB_w_003_8422x21-3/13	xxx
608-3	NC296*6xTcb1+MB_w_003_8422x21-3/13	0
608-4	NC296*6xTcb1+MB_w_003_8422x21-3/13	0
608-5	NC296*6xTcb1+MB_w_003_8422x21-3/13	42
608-6	NC296*6xTcb1+MB_w_003_8422x21-3/13	xxx
608-7	NC296*6xTcb1+MB_w_003_8422x21-3/13	0
608-8	NC296*6xTcb1+MB_w_003_8422x21-3/13	55
608-9	NC296*6xTcb1+MB_w_003_8422x21-3/13	0

F₂s

F₂s of a cross between NC476 with the homozygous *Tcb1* and *Gal-m* line, were planted ear-to-row in nursery and evaluated for resistance to “normal” pollen pollination in summer nursery 2014. Six of nine ears evaluated set zero kernels, two set thirty kernels and one set forty kernels, for an overall total of 11.1 kernels per ear. Results are presented in Table 193.

Table 193. Results of *gal* nursery evaluation of *Tcb1+Gal-m* F₂s with NC476

Description	Top Ear #K
993-1_NC476xTcb1+Gal-M_F2_4___8074-bk6/11	0
993-2_NC476xTcb1+Gal-M_F2_4___8074-bk6/11	0
993-3_NC476xTcb1+Gal-M_F2_4___8074-bk6/11	40
993-4_NC476xTcb1+Gal-M_F2_4___8074-bk6/11	0
993-5_NC476xTcb1+Gal-M_F2_4___8074-bk6/11	30
993-6_NC476xTcb1+Gal-M_F2_4___8074-bk6/11	0
993-7_NC476xTcb1+Gal-M_F2_4___8074-bk6/11	30
993-8_NC476xTcb1+Gal-M_F2_4___8074-bk6/11	0
993-9_NC476xTcb1+Gal-M_F2_4___8074-bk6/11	0

Evaluation of an identical cross showed different results. Five of nine ears evaluated set zero kernels, however, the remaining four ranged in set from five kernels to 500 kernels on each ear, for an overall average of 93.9 kernels per ear. Results are presented in Table 194.

Table 194. Results of additional *gal* nursery evaluation of *Tcb1+Gal-m* F₂s with NC476

Description	Top Ear #K
996-1_NC476xTcb1+Gal-M_F2_4___8075-bk6/11	5

Table 194. Continued

Description	Top Ear #K
996-2_NC476xTcb1+Ga1-M_F2_4_8075-bk6/11	30
996-3_NC476xTcb1+Ga1-M_F2_4_8075-bk6/11	400
996-4_NC476xTcb1+Ga1-M_F2_4_8075-bk6/11	0
996-5_NC476xTcb1+Ga1-M_F2_4_8075-bk6/11	0
996-6_NC476xTcb1+Ga1-M_F2_4_8075-bk6/11	0
996-7_NC476xTcb1+Ga1-M_F2_4_8075-bk6/11	4
996-8_NC476xTcb1+Ga1-M_F2_4_8075-bk6/11	500
996-9_NC476xTcb1+Ga1-M_F2_4_8075-bk6/11	0
996-9_NC476xTcb1+Ga1-M_F2_4_8075-bk6/11	0

Yield Trials

Comparisons are presented as percent yield of the highest yielding commercial check over years (Pioneer 31G66 at 131 bu/A). The coefficient of variation (CV) for yield was 12.08, with a least significant difference of 10.9. Comparison with Blue River 71PM50, a commercial hybrid with a pollen matching system intended to prevent GM cross-contamination, are also presented. Results are presented in Table 195. Yields of double-cross hybrids in the same trial are presented with comparisons as percent yield of the highest yielding check and of 71PM50. One line was dropped from this experiment due to subsequent results identifying it as a non-DGF. Results are presented in Table 196. Analysis of variance tables for individual traits are presented in Appendix III.

Table 195. F₁ topcross (to NC320xNC368) yield trial results at 5 locations over 2 years, comparisons with P31G66 and 71PM50

Yield (bu/A)	% P31G66	% 71PM50	Pedigree	Source
96	73.28%	95.05%	320.368xJ78	1161-05/12
107	81.68%	105.94%	476.HBA1xJ78RH127x29-d/11	1179-02/12
109	83.21%	107.92%	476.HBA1xJ78bk0d4_133x35-d/11	1214-05/12
104	79.39%	102.97%	476.HBA1xJ300_01_R121x23-b/11	1228-01/12
101	77.10%	100.00%	476.HBA1xJ300_03_R121x23-b/11	1228-02/12
86	65.65%	85.15%	476.HBA1xJ300R121x23-e/11	1231-02/12
102	77.86%	100.99%	476.HBA1xJ300R121x23-e/11	1231-04/12
92	70.23%	91.09%	PHZ51xJal78_RH132x35-c/11	1222-02/12
100	76.34%	99.01%	PHZ51xJal78_RH132x35-c/11	1222-03/12
107	81.68%	105.94%	PHZ51xJal78_RH132x35-d/11	1223-01/12
103	78.63%	101.98%	PHZ51xJ78_red00_RH132x35-d/11	1223-02/12
97	74.05%	96.04%	PHZ51xJ78_redR132x35-d/11	1223-06/12
110	83.97%	108.91%	PHZ51xJal78_RH132x35-d/11	1223-09/12
110	83.97%	108.91%	PHZ51xJal78_RH132x35-d/11	1223-10/12
100	76.34%	99.01%	PHZ51xJ78_redR132x35-g/11	1226-01/12
102	77.86%	100.99%	PHZ51xJ78_redR132x35-g/11	1226-02/12
98	74.81%	97.03%	PHZ51xJ78_redR132x35-g/11	1226-04/12
99	75.57%	98.02%	PHZ51xJal78_RH132x35-g/11	1226-05/12
103	78.63%	101.98%	PHZ51xJ78_redR132x35-g/11	1226-06/12

Table 195. Continued

Yield (bu/A)	% P31G66	% 71PM50	Pedigree	Source
97	74.05%	96.04%	PHZ51xJal78_RH132x35-g/11	1226-07/12
111	84.73%	109.90%	PHZ51xJal78_RH132x35-g/11	1226-08/12
105	80.15%	103.96%	PHZ51xJal78_RH132x35-g/11	1226-09/12
131	100.00%	129.70%	DeKalb 697	697
101	77.10%	100.00%	Blue River 71PM50	71PM50
131	100.00%	129.70%	Pioneer 31G66	31G66
CV Yield	12.08		Average Experimental Yield	101.77
LSD (.05)	10.93		Standard Error Exp. Yield	6.16

Table 196. Double-cross hybrid yield trial results, comparisons with P31G66 and 71PM50

Yield (bu/A)	% P31G66	% 71PM50	Pedigree	Source
108	82.44%	106.93%	(320.368xJ304)x(476.HBA1xJ78)	1170-8x1214-5
95	72.52%	94.06%	(320.368xJ304)x(PHZ51xJal78)	1172-3x1222-2
52	39.69%	51.49%	(320.368xJ78)x(476.HBA1xJ300)	1161-5x1228-2
113	86.26%	111.88%	HBA1.NC476xNC368.NC320	818x817
131	100.00%	129.70%	DeKalb 697	697
101	77.10%	100.00%	Blue River 71PM50	71PM50
131	100.00%	129.70%	Pioneer 31G66	31G66
CV Yield	12.08		Average Experimental Yield	85
LSD (.05)	10.93		Standard Error Exp. Yield	29.31

A second yield trial at the same five locations in a single year(2014) contained F₂ topcrosses, as well as some additional F₁ topcrosses, and *Tcb1*-containing topcrosses. Additional years of data are needed to draw conclusions about these yields, but results appear promising for the utilization of DGFs. Results are presented in Appendix II Table 3.

Discussion

Our study revealed the presence of isolation mechanisms present in specialty types of maize as proposed by Sanchez et al. (2011). We identified alleles conferring dominant resistance to *gal* pollination in Jalisco 78, Jalisco 300, Jalisco 304, Zacatecas 40, Zacatecas 182, Guanajuato 100, Guanajuato 141, Guanajuato 181, Michoacán 412, Z07011, and Palomero tipo de Chihuahua 148. All of the accessions initially evaluated in this study appeared to have some resistance to pollination by *gal* pollen, but kernel counts were lowest in those mentioned above. The screening revealed alleles conferring pollen isolation are abundant in the specialty types evaluated, although the frequency of these alleles is highly variable, making adequate sampling key to their identification. There is also large sample-to-sample variability. For example, within Jalisco 78, comparison of 9525-7 F₁s with 9526-9 F₁s, both of which come from the same Jalisco 78 source, shows the amount of variation present for these factors among even F₁ plants from the same accession and source (Table 2 and Table 4). In this case, the former appears almost uniformly resistant to *gal*, while the latter appears almost entirely susceptible. This highlights the need for extensive sampling to identify the best possible allelic combinations for producer use. The high incidence of these alleles in

specialty types of maize is not entirely surprising, indicating that these alleles were likely important in the preservation of specialty types historically.

Like the *Gal* and *Tcb1* systems, the newly discovered resistance to *gal* pollination appears to have full-strength and attenuated versions. Although we hoped to identify novel isolating mechanisms, crosses with tester stocks by Jerry Kermicle showed that there appear to be no new loci in the material we evaluated from Jalisco 78 and Jalisco 304, although these are the only sets of our materials that have been evaluated in this detail to date (Kermicle, *personal communication*). This screening also showed that Jalisco 78 segregates for both *Tcb1* and *Gal-s*, meaning it will be important to cross lines derived from this accession to both *Gal-s* and *Tcb-1* testers to know which pollen isolation system/systems are present in a given line. Further examination of the full set of material should be carried out to determine if there are any novel alleles or genes in this collection of accessions.

The screening of lines resulted in identification of pollen isolation mechanisms from several specialty types of maize, but the dominance and especially stability of these factors still must be established. There are many possible scenarios for the genetic architecture controlling these mechanisms, but the most likely is control by a single dominant gene or control by a gene with modifiers. For a dominant factor, we expect that a selected heterozygous line, when crossed as male should segregate 1:1 resistant to *gal*: accepting *gal* if we have a single dominant gene. When a selected line is backcrossed, we expect that it will either segregate 1:1 if heterozygous or will be uniformly resistant to *gal* if homozygous, depending on the constitution of the selected plant. However backcrossing will be necessary to determine if the line contains a dominant allele, or contains alleles at least acting

dominantly, passing along all necessary modifiers with the gene. Several lines putatively act as if they contain dominant factors, but the extensive work required to determine this for sure has not been completed. The most promising lines for DGFs are summarized in Table 197.

Table 197. Most promising lines for *gal* resistance by accession

Accession	Lines
Jalisco 78	1222-2, 1223-10, 1226-4, 1226-5, 1226-9
Jalisco 300	1228-2
Jalisco 304	1162-9
Guanajuato 100	9529-6, 9530-6
Guanajuato 141	9531-7, 9532-1, 9532-14
Guanajuato 181	9533-11
Michoacán 412	9059-5, 9536-4.
Benz 875	9522-2
Palomero-CHH 148	9541 Series

For effective utilization of lines containing pollen isolation systems, the mechanisms must be effectively backcrossed into adapted material. Our study shows that the ability to backcross lines effectively is variable between lines, with some lines maintaining resistance within the derived lines and others appearing to break down through backcrossing. For example, 1226-5 from Jalisco 78, which set few kernels as an F₁ in an isolation block appears to be effectively backcrossed into NC lines (Table 50), maintaining resistance through a BC₂. However, 9539-9 from Zacatecas 182, which set zero kernels as an F₁ in an isolation block appears to break down when backcrossed (Table 115). This particular line shows increased

seed set in the BC₁ when compared with the F₁. In lines where seed set increases in successive generations, we observe that the derived lines fall into two general categories (weakly resistant and non-resistant), with the weakly resistant lines setting an intermediate number of kernels, and the non-resistant losing all resistance to *gal* pollination, resulting in a fully set ear. This weakening of the barrier through backcrossing may be indicative of modifier loss. If the genetic architecture of this trait is, in fact, a gene and several modifiers that induce complete resistance to *gal* pollination, then identification of lines with tightly linked modifiers will be key to effective utilization of these lines through backcrossing. It is possible that the sources that are effectively backcrossed are sources that fit this description, and those that have less tightly linked modifiers do not maintain barrier strength due to modifier loss through recombination. It seems probable that pollen blockage is governed by multiple modifiers, the loss of one/some of them causing a weakened barrier; however, more extensive investigation of this topic is necessary. Beginning the backcrossing process with the more advanced material should give a better understanding of the ability to use these lines in backcrossing, and may also be helpful in identifying how modifiers may act on the phenotype. It is also possible that backcrossing into certain lines may be more effective than into others, based on the genetic background of the lines. There is also the question of the effectiveness of backcrossing *Tcb1+Gal-m* lines into adapted material. Results for this backcrossing are also variable, but the majority of BC₅ lines were shown to have maintained the ability to block non-target pollen, indicating the backcrossing was effective.

Another important component of effective utilization of these lines is the ability to produce hybrids with competitive yield. Quite simply put, if a line does not yield adequately, then its

use by producers will be very limited. Examination of yield trials provides mixed results in this area (Table 195). Results of a two-year yield trial over five locations showed that topcrosses of F_1 lines yielded 77.69% of the highest yielding check on average (P31G66 at 131 bu/A). Although these yields seem quite reduced compared to the highest yielding check, comparison with Blue River 71PM50, a commercial hybrid with a pollen-matching system, shows that performance of these topcrosses is quite competitive for producer use, yielding 100.7% of 71PM50. Further examination of these comparisons shows that some, like the 1226-8 containing topcross are yielding 109.9% of 71PM50 on average. This kind of yield performance is promising for the potential use of these lines by specialty producers. These yield trial results, in general, suggest that production of DGF-containing hybrids for specialty producers has the potential provide competitive yield, while reducing the risk of cross contamination, in turn reducing the risk of profit loss. Examination of double-cross hybrids in the same experiment suggests that the use of double-crosses may also be a viable option for specialty producers and specialty-type seed producers (Table 196). Average yield for double-cross hybrids was low, but this list is far from exhaustive, and the (1170-8x1214-5) hybrid shows that yield potential is present for double cross hybrids. Further examination of possible combinations is necessary to accurately gauge the potential of these lines, but the idea shows potential. Examination of yield trial results of new F_1 s and F_1S_1 (F_2) topcrosses at 5 locations in one year once again provided mixed results. Topcrosses, on average, yielded 93.65 bu/A, 64.14% of the highest yielding commercial check (P31G66 at 146 bu/A). The highest yielding topcross was 8213-2/xP320*3S3*2.TcBCS1, a *Tcb1+Gal-m* backcross topcrossed to standard testers, which yielded 114 bu/A, 78.08% of P31G66. Even the worst

entry in this trial yielded 53.42% of the highest yielding commercial check, which is promising in light of the increased profit specialty types can receive compared to #2 yellow corn prices on the market (<http://ams.usda.gov/mnreports/lbfnof.pdf>). Certified Organic producers, for example, would still have increased profit with the yields observed in these trials due to the high price of organic corn relative to conventional corn. Recently, organic prices have been roughly double those of conventional corn, so a yield reduction of 49% would still be a profitable endeavor for producers at this price, and the lines evaluated are all yielding substantially above that point, relative to the highest yielding check. The use of hybrids with pollen isolating systems also reduces the potential for profit loss at the buying point, as restrictions on standards for organic grain become increasingly strict. The potential for use in areas where isolation distances are not readily achievable also provides a strong incentive for use, and protects a producer's right to choose Certified Organic or conventional production methods without regard to their neighbor's planting decisions. Two *Tcb1+ Gal-m* backcross lines that were shown to effectively block non-target pollen were entered into the yield trial (Appendix II Table 3) and both yielded 114 bu/A, 78.08% of the highest yielding check, suggesting that *Tcb1+Gal-m* lines are capable of overcoming the yield drag associated with these alleles.

We have shown that specialty types of maize contain alleles conferring resistance to *gal* pollination (*Gal-s* in some cases), and that those alleles are fairly abundant in the populations, although frequency is variable between samples, indicating heterogeneity within the populations. We have, at least thus far, identified no novel systems of resistance to *gal* pollination, but have observed that some lines segregate for both *Gal-s* and *Tcb1* within the

population, indicating that derived lines must be extensively evaluated to determine which alleles are present in the lines if they are to be used for breeding purposes. We have also demonstrated that some of these lines appear to act as dominants, but that success in backcrossing is variable, possibly due to the presence of variable linkage strength with positive modifiers. The derived lines come with a yield reduction, as expected with crossing with exotic material, but yield is still at levels high enough to prove economical based on the often-higher prices of specialty types of corn. We believe that these lines have the potential to serve as a useful and economical way to protect the producer's right to choose whatever production system they prefer, without it being dictated by the planting decisions of neighboring farms, as well as protecting specialty types from GM contamination in production areas where isolation distances are not achievable.

Literature Cited

- de la Cruz, L., J. Sanchez, J. Ron, B. Baltazar, J.A. Ruiz, & M.M. Morales. (2008). El factor gametofítico-1 (ga1) en híbridos comerciales de maíz de México. *Revista Fitotecnia Mexicana*, 31(1), 57-65.
- Demerec, M. (1929). Cross-sterility in maize. *Indukt Abstamm Vererbungsl*, 50, 281-291.
- Devos, Y., Demont, M., Dillen, K., Reheul, D., Kaiser, M., & Sanvido, O. (2009). Coexistence of genetically modified (GM) and non-GM crops in the European Union. A review. *Agronomy for Sustainable Development*, , 11-30.
- Halsey, M.E., K.M. Remund, C.A. Davis, M. Qualls, P.J. Eppard, and S.A. Berberich. 2005. Isolation of maize from pollen-mediated gene flow by time and distance. *Crop Sci* 45:2172-2185
- Kermicle, J., & Evans, M. (2005). Pollen–pistil barriers to crossing in maize and teosinte result from incongruity rather than active rejection. *Sexual Plant Reproduction*, 18, 187-194.
- Kermicle, J. L., Taba, S., & Evans, M. M. S. (2006). The gametophyte-1 locus and reproductive isolation among *zea mays* subspecies. *Maydica*, 51(2), 219-225.
- Lu, Y., Kermicle, J., & Evans, M. (2014). Genetic and cellular analysis of cross-incompatibility in *zea mays*. *Plant Reproduction*, 27, 19-29.
- Nelson, O. (1952). Non-reciprocal cross-sterility in maize. *Genetics*, 37, 101-124.
- Nelson, O. (1994). The gametophyte factors of maize. *The maize handbook* (pp. 496-503). New York: Springer-Verlag.
- Organic Farmers' Agency for Relationship Marketing (OFARM), Food and Water Watch. (2014). "Organic farmers pay the price for contamination" issue brief. Retrieved 07/28, 2014, from http://documents.foodandwaterwatch.org/doc/GMO_contamination.pdf
- Sanchez, J., Padilla, J., De la Cruz, L., Ron, J., Holland, J., Krakowsky, M., et al. (2011). Use of gametophytic isolating mechanisms for maize. *Plant Breeding News*, 230, 1.14.
- Schwartz D. (1950). The analysis of a case of cross-sterility in maize. *Proceedings of the National Academy of Science*, 36, 719-724.

Weber, W., & T. Bringezu, I. Broer, J. Eder, and F. Holz. (2007). Coexistence between GM and non-GM maize crops – tested in 2004 at the field scale level. *Journal of Agronomy and Crop Science*, 193, 79-92.

Chapter 3: Screening of Maize Germplasm for Alleles Conferring Resistance to the Male-Only Variant of *gametophyte factor 1 (Gai-m)* Pollination

The 2014 planting season saw a crop in which 93% of maize (*Zea mays* L.) was planted to genetically modified (GM) varieties, an increase of 68% from 2000 (NASS, 31 July 2014). As the number of GM maize acres rises, there is ever-increasing concern over the coexistence of GM and non-GM maize. This is especially pertinent to organic corn growers who need to produce GM-free stocks to maintain certifications, as well as preserve the price premium they receive for their crops. Additionally, U.S. grain exports are limited by the abundant presence of transgenes in maize due to purity standards, like those of the European Union, that have a very low (0.5%) contamination threshold for GM labeling, and an even lower (0%) threshold for organic products (European Commission, 2004). These standards are difficult to achieve for conventional growers and nearly impossible to achieve for organic growers, due to the proximity of GM and non-GM production (Goggi et al., 2006).

Maize is a monoecious, diclinous, crop with wind-borne pollen dispersal from a terminal inflorescence, the tassel. Due to this dispersal method, many standards have been established to maintain purity in non-GM maize in areas where it coexists with GM maize. These standards involve isolation distances of 15 to 800m between fields in Europe, and can involve planting of extensive buffers; measures which are often not economically or spatially feasible (Devos et. al., 2009). However, even if implemented, isolation is not always completely effective. Goggi et al. (2007) demonstrated that although outcrossing percentage dropped to 0.4% at 35m, it was not completely effective even at 250m from the pollen

source. Numerous other methods have been devised to preserve purity in non-GM crops, including physical barriers, GM-free production zones, as well as temporal and spatial isolation between pollen sources, all of which require additional input on the part of the producer to maintain genetic purity (Devos et al., 2007). This creates a litany of problems, ranging from restrictions on producer choice to substantial losses to a producer, possibly even putting small producers out of business due to a lack of space to prevent contamination.

Maize varieties with the inability to set seed when pollinated by another variety have been known since 1929, and are referred to as cross-incompatible (Nelson, 1952). The use of varieties of this type for protection of specialty corns has been long advocated, and there has been renewed interest in production of this type of variety with the increase in GM maize production (Nelson 1952, Liu, 2014). The first, and most studied, factor inducing cross-incompatibility is *gametophyte factor 1* (*gal*). As its name implies, it is a gametophytic allele-matching system, in which certain pistil genotypes must match the genotype of the pollen granule in order for fertilization to occur (Kermicle and Evans, 2005). In plants homozygous (*Gal /Gal*) or heterozygous (*Gal /gal*) for the *Gal* allele, *Gal* pollen is preferred over *gal* pollen, with the recessive pollen achieving fertilization in only 0-4% of the ovules in the presence of competition from *Gal* (Schwartz, 1950). In the homozygous recessive (*gal /gal*) case, pollen carrying either allele variant is equally competitive in fertilization. In the absence of competition between pollen types, recessive pollen will usually fertilize all ovule types. A third variant at this locus, *Gal-s*, has a stronger effect, and conditions nonreciprocal cross-sterility. In this case, fertilization by *gal* pollen completely

fails on silks that are homozygous for *Gal-s*, even in the absence of competing pollen, while ears heterozygous for *Gal-s* usually produce partial seed set (Schwartz, 1950). *Gal-s* pollen will, however, induce full fertilization on *gal/gal* plants. An additional allele of *gal*, designated *Gal-m*, has male-only action and is cross neutral. Plants containing *Gal-m* can fertilize all genotypes, including *Gal-s* homozygotes, and accept pollen from all other pollen classes (*gal*, *Gal-s*, *Gal-m*; Kermicle, Taba and Evans, 2006).

The promiscuous nature of the *Gal-m* allele is problematic in the production of effective cross-incompatible varieties for non-GM maize producers due to its ability to overcome *Gal-s* homozygotes. The presence of *Gal-m* in sympatric GM maize would render that cross-incompatibility system useless, showing an obvious need for the continued consideration of the genotype of neighboring maize. This is also especially problematic, since the only way to establish the presence of the *Gal-m* genotype is to cross to a *Gal-s* tester. Luckily, studies have shown that virtually all United States field corn varieties evaluated are *gal* homozygotes, meaning that the implementation of *Gal-s* homozygous types could currently be effective in preventing cross-contamination (Nelson, 1952). However, a recent screening of commercial varieties planted in Mexico revealed that the majority of the hybrids (55%) are homozygous for *Gal-m*, while the remainder was distributed 20% *Gal-m/gal* heterozygotes and 25% *gal* homozygotes (de la Cruz et al., 2008). It seems likely that, as agriculture becomes increasingly global, commercial varieties in the U.S. will eventually contain the *Gal-m* allele through the use of exotic germplasm. To date, there are several NC inbred lines, one ex-PVP line (PHV63), and one commercial

hybrid known to contain the *Gal-m* allele, meaning that the successful use of cross-incompatibility systems on any large scale will require isolation from such hybrids, or a cross-incompatible system with resistance to pollination by *Gal-m* must be identified (Goodman, 2011; Lennon, 2014; Hoegemeyer, *personal communication*). In our study, the first of its kind, we examine several accessions of Mexican origin that putatively contain Dominant Gametophyte Factors for the presence of resistance to *Gal-m* pollination.

Materials and Methods

Plant Material

The experiment contained lines all previously evaluated for the presence of Dominant Gametophyte Factors (DGFs) and identified as putatively containing DGFs. These lines have been identified as resistant, or at least putatively resistant, to *gal* pollination (sometimes to *Gal-s*). The mechanism of the resistance has not been established for these lines, so it is possible they contain *Gal-s*, *Tcb-1*, novel alleles/loci, or combinations of these. Evaluated accessions are summarized in Table 198.

Table 198. Accessions used in this study and Plant Introduction numbers

Accession	PI Number
Jalisco 78	PI 483568
Jalisco 300	PI 484570
Jalisco 304	PI 484574
Zacatecas 40	PI 629262
Zacatecas 182	PI 646105

Table 198. Continued

Accession	PI Number
Guanajuato 100	PI 629166
Guanajuato 141	PI645801
Guanajuato 181	PI 628428
Michoacán 412	PI 629228
Negrito-CRI223	PI 471857

Material Development

Accessions were crossed to synchronously flowering inbreds (summarized in Appendix II Table 1) and then individual F₁ plants were evaluated for the presence of gametophyte factors by pollinating the top ear of individually numbered plants with pollen from the corresponding line or an appropriate substitute; presence of gametophyte factors was indicated by the absence of seed set (barren cobs) on the F₁. Second ear selfs were obtained on many of these plants to create S₁s. Evaluations were carried out in nurseries at Central Crops Research Station in Clayton, NC and at 27 Farms in Homestead FL. The same plants were also usually backcrossed to the appropriate inbred/ex-PVP line, and only pollinations with no seed set on the corresponding F₁ were harvested. Backcrosses of plants testing positive for gametophyte factors (barren cobs) were planted in winter nursery and many were selfed as individually numbered plants within plots to create BC₁S₁s. These BC₁S₁s were entered into the experiment, although additional evaluation/backcrossing of these lines continued. In summer 2013, previously successful lines were once again evaluated for the

presence of gametophyte factors by pollinating with non-*Gal* pollen, and were backcrossed to the inbred line matching the respective pedigrees, creating BC₂S₁ lines. Pollinations from plants containing gametophyte factors were harvested and planted in winter nursery in Homestead, FL where they were selfed, creating BC₂S₂s. Additional first year evaluations were made each year, and interesting material at its present state (slightly inbred) was placed into the experiment for evaluation for *Gal-m* resistance. Additional material containing gametophyte factors was also identified during the development of BC lines for the Allelic Diversity Project of GEM (Sood et al, 2014). This material was obtained and entered into the experiment. Pedigrees where derived lines were found not to contain gametophyte factors were not included or advanced, leaving only material and lines derived from it that putatively contain gametophyte factors. All of these materials (F₂S, BC₁S₁S, BC₁S₂S, BC₂S₁S and GEM material) were entered into the experiment. Initial crosses in the 2013 winter nursery with NC390xNC394, a *Gal-m* containing hybrid, revealed that three lines from Jalisco 78 (298-1, 299-1 and 285-4) all from 1222-2 contained some resistance to *Gal-m* pollination, producing at least some bare cobs in paired rows. From this, more extensive investigation was conducted.

Experimental Conditions

Five hundred and seventy experimental lines, plus checks for *Gal-m*, were planted in an isolation block on April 28, 2014 at Central Crops Research Station in Clayton, NC. Twenty kernels were planted per plot, and plants were thinned to 8-10 plants at approximately the V4 growth stage. This field followed standard corn isolation protocols,

being planted far enough away from other corn that risk of contamination was minimized. The male pollen parent was NC390xNC394 a hybrid combination of two NCSU inbreds known to carry *Gal-m* and a prolific pollen producer. Experimental lines were planted in single 2m rows, four rows wide on 0.97m spacings, surrounded by two rows of pollen parent on both sides. Delay plantings of male parent were hand planted at approximately seven-day intervals for 28 days to ensure adequate pollen supply during evaluation. Additional rows of male parent were planted beside the experimental plot to ensure adequate pollination. Experimental lines were detasseled, and silking dates of each plot were recorded. Plots that silked after July, 20 were considered “late” for scoring purposes due to sparse pollen availability after this date. At approximately 30 days after silking, all ears in each plot were husked, and kernel counts, as well as number of ears, were recorded for each row. Data was also collected on segregation within plot, and “strength” of the pollen barrier, if one was present. Barrier strength fell into three categories, full-strength, which produces bare ears, weakened, which produces reduced seed set, and no barrier, which produces full ears.

Results

Field evaluation of selected lines revealed the presence of several accession backgrounds conferring resistance to *Gal-m* pollination. One hundred and two plots were identified as resistant to pollination by *Gal-m* based on the number of kernels per ear being less than or equal to 3 ($\#K/\#E \leq 3$) for a given plot. Of these resistant lines, the Jalisco 300, Jalisco 304 and Zacatecas 182 lines were all derived from single F₁ single plant selections. The Jalisco 78-containing lines represented twelve F₁ single plant selections based on the

putative presence of dominant gametophyte factors, for a total of fifteen F₁ selections resulting in resistant lines. It should be noted that many more Jalisco 78-containing lines were evaluated than were those of other sources. Single-plant selections where resistance was identified are summarized in Appendix II Table 4. Numbers of identified resistant lines are summarized in Table 199.

Table 199. *Gal-m* resistant lines identified from evaluated accessions

Accession	Number of Resistant Lines Identified
Jalisco 78	95
Jalisco 300	5
Jalisco 304	1
Zacatecas 182	1
Total	102

In addition, two hundred twenty-two plots were identified as segregating for full-strength *Gal-m* resistance (bare cobs) when pollinated based on field observation. These lines are derived from 36 F₂ single-plant selections, based on the putative presence of dominant gametophyte factors. One hundred and sixty-six plots were identified as segregating for a weakened barrier to *Gal-m*. These ears had obviously reduced seed set when pollinated with *Gal-m* but did not produce bare ears. Due to lines segregating for multiple resistance types, numbers do not necessarily sum to total number of lines evaluated. These counts also include those fixed for a given resistance type. Results are presented in

Table 200.

Table 200. Lines containing full-strength, weakened and no resistance to *Gal-m* pollination

Accession	Full-Strength Resistance	Weakened Resistance	No Resistance	Total Plots Evaluated
Guanajuato 100	1	7	11	19
Guanajuato 141	4	10	22	35
Guanajuato 181	2	10	13	25
Jalisco 78	178	99	70	296
Jalisco 300	17	5	5	29
Jalisco 304	11	9	34	49
Michoacán 412	1	8	3	11
Zacatecas 40	0	2	29	32
Zacatecas 182	7	9	45	58
Negrilo-CRI223	1	7	2	10
Total	222	166	234	570

Since the material evaluated represents various levels of inbreeding from original crosses evaluated simultaneously, it is informative to present and discuss the data in groupings divided by original F₁. Several plots silked too late for evaluation, and many were, as expected, not resistant to *Gal-m*. The results of the latter are presented in the appendix tables. We present data here for plots that appear resistant or appear to segregate for resistance in this section.

Jalisco 78

1222-2

1222-2 is a cross between PHZ51 and Jalisco 78, and the” -2” designation indicates that it was the second plant in the original row, in this case an F₁ row planted in 2012 summer nursery. The selfed seed of this plant was planted out in winter nursery and similarly numbered by plant and selfed. Seed from each of these F₂S₁ plants was evaluated in isolation rows for resistance to *Gal-m* and eight were found to be resistant without segregation within row. The remaining four plant rows did segregate for resistance to *Gal-m*, containing mixes of bare and set ears within the row. Results are presented in Table 201.

Table 201. Results of 1222-2 F₂S₁ evaluation for *Gal-m* resistance

Row Pedigree Source	# K	# Ears	Seg?	Type
5329_PHZ51xJal78__1222-02_F2S1__8348-1/12	6	9	n	Full
5330_PHZ51xJal78__1222-02_F2S1__8348-2/12	17	8	n	Full
5331_PHZ51xJal78__1222-02_F2S1__8348-3/12	3	9	n	Full
5332_PHZ51xJal78__1222-02_F2S1__8348-4/12	100	8	y	Full
5333_PHZ51xJal78__1222-02_F2S1__8348-5/1	9	8	n	Full
5334_PHZ51xJal78__1222-02_F2S1__8348-6/12	14	9	n	Full
5335_PHZ51xJal78__1222-02_F2S1__8348-7/12	500	8	y	Full
5336_PHZ51xJal78__1222-02_F2S1__8348-8/12	2	9	n	Full
5337_PHZ51xJal78__1222-02_F2S1__8348-9/12	0	8	n	Full
5338_PHZ51xJal78__1222-02_F2S1__8348-10/12	200	7	y	Full
5339_PHZ51xJal78__1222-02_F2S1__8348-11/12	3	5	n	Full
5340_PHZ51xJal78__1222-02_F2S1__8348-12/12	259	8	y	Full-Weak-None

These individually numbered plants were once again selfed and the seed of 3 of those selfs was evaluated for resistance to *Gal-m* pollination. Results are presented by previous generation source. Row 298 is the result of selfed seed from plant 8348-1 in the 2012 nursery. Plants were similarly numbered in summer 2013 and selfed. The same applies for rows 299 and 300 with their respective previous generations. When evaluated, selfs of all F₂S₂ plants from row 298 were found to be *Gal-m* resistant and the resistance was not segregating within the isolation rows. Row 299 selfed seed resulted in seven isolation rows resistant to pollination and not segregating for resistance. The remaining four isolation rows derived from row 299 were all segregating for bare ears within row. Selfed seed of row 300 was also evaluated, and nine isolation plots were observed to be resistant to pollination, and this resistance did not segregate. Results are presented in Table 202.

Table 202. Results of 1222-2 F₂S₂ evaluation for *Gal-m* resistance

Prev. Gen.	Row Pedigree Source	# K	# Ears	Seg?	Type
8348-1	5446_PHZ51xJal78_1222-02/12_F2S2_298-1/13	2	8	n	Full
8348-1	5447_PHZ51xJal78_1222-02/12_F2S2_298-2/13	0	7	n	Full
8348-1	5448_PHZ51xJal78_1222-02/12_F2S2_298-3/13	1	5	n	Full
8348-1	5449_PHZ51xJal78_1222-02/12_F2S2_298-4/13	1	9	n	Full
8348-1	5450_PHZ51xJal78_1222-02/12_F2S2_298-5/13	14	9	n	Full
8348-1	5451_PHZ51xJal78_1222-02/12_F2S2_298-6/13	0	9	n	Full
8348-1	5452_PHZ51xJal78_1222-02/12_F2S2_298-7/13	4	7	n	Full
8348-2	5453_PHZ51xJal78_1222-02/12_F2S2_299-1/13	55	8	y	Full
8348-2	5454_PHZ51xJal78_1222-02/12_F2S2_299-2/13	11	9	n	Full
8348-2	5455_PHZ51xJal78_1222-02/12_F2S2_299-3/13	250	9	y	Weak
8348-2	5456_PHZ51xJal78_1222-02/12_F2S2_299-4/13	0	8	n	Full

Table 202. Continued

Prev. Gen.	Row Pedigree Source	# K	# Ears	Seg?	Type
8348-2	5457_PHZ51xJal78_1222-02/12_F2S2_299-5/13	157	7	y	Full-Weak
8348-2	5458_PHZ51xJal78_1222-02/12_F2S2_299-6/13	3	5	n	Full
8348-2	5459_PHZ51xJal78_1222-02/12_F2S2_299-7/13	4	9	n	Full
8348-2	5460_PHZ51xJal78_1222-02/12_F2S2_299-8/13	100	7	y	Full-Weak
8348-2	5461_PHZ51xJal78_1222-02/12_F2S2_299-9/13	0	6	n	Full
8348-2	5462_PZ51xJal78_1222-02/12_F2S2_299-10/13	0	7	n	Full
8348-2	5463_PZ51xJal78_1222-02/12_F2S2_299-11/13	0	7	n	Full
8348-3	5466_PHZ51xJal78_1222-02/12_F2S2_300-2/13	14	9	n	Full
8348-3	5467_PHZ51xJal78_1222-02/12_F2S2_300-3/13	0	8	n	Full
8348-3	5468_PHZ51xJal78_1222-02/12_F2S2_300-4/13	0	8	n	Full
8348-3	5469_PHZ51xJal78_1222-02/12_F2S2_300-5/13	1	9	n	Full
8348-3	5470_PHZ51xJal78_1222-02/12_F2S2_300-6/13	1	8	n	Full
8348-3	5471_PHZ51xJal78_1222-02/12_F2S2_300-7/13	1	6	n	Full
8348-3	5472_PHZ51xJal78_1222-02/12_F2S2_300-8/13	2	5	n	Full
8348-3	5473_PHZ51xJal78_1222-02/12_F2S2_300-9/13	1	9	n	Full

Selfed seed from the previous generation was planted ear-to-row in 2013 winter nursery to produce rows 8410 and 8411. Row 8410 numbered plants are derived from plant 298-1, which had 0.28 kernels per ear when evaluated for resistance to *Gal-m*, meaning it was resistant to pollination and was not segregating. When examining lines derived from its self, all six F₂S₃s were found to resistant, and the resistance was not segregating. Row 8411 was derived from selfed seed from plant 299-1 which, when evaluated for *Gal-m* resistance had 6.88 kernels per ear, meaning it did not meet the definition of “resistant” to pollination, but was segregating for resistance within isolation row. Evaluation of individual plant selfs of

row 8411 resulted in one row segregating for a weakened barrier, one row segregating between full-strength and weakened barrier and three rows that were resistant and not segregating. Results are presented in Table 203.

Table 203. Results of 1222-2 F₂S₃ evaluation for *Gal-m* resistance

Prev. Gen.	Row Pedigree Source	# K	# Ears	Seg?	Type
298-1	5610_PHZ51xJ78__1222-02/12_F2S3_8410-1/13	0	6	n	Full
298-1	5611_PHZ51xJ78__1222-02/12_F2S3_8410-2/13	0	6	n	Full
298-1	5612_PHZ51xJ78__1222-02/12_F2S3_8410-3/13	2	8	n	Full
298-1	5613_PHZ51xJ78__1222-02/12_F2S3_8410-4/13	0	6	n	Full
298-1	5615_PHZ51xJ78__1222-02/12_F2S3_8410-6/13	0	8	n	Full
299-1	5616_PHZ51xJal78__1222-02/12_F2S3_8411-1/13	143	5	y	Full-Weak
299-1	5617_PHZ51xJal78__1222-02/12_F2S3_8411-2/13	800	8	y	Weak
299-1	5618_PHZ51xJal78__1222-02/12_F2S3_8411-3/13	500	9	y	Full
299-1	5619_PHZ51xJal78__1222-02/12_F2S3_8411-4/13	0	9	n	Full
299-1	5620_PHZ51xJal78__1222-02/12_F2S3_8411-5/13	0	9	n	Full
299-1	5621_PHZ51xJal78__1222-02/12_F2S3_8411-6/13	6	8	n	Full

The F₂S₂s were also crossed again to various standard lines in summer 2013 and evaluated for *Gal-m* resistance in 2014. Of the seven evaluated, two segregated for a full-strength barrier, two were fixed for full-strength barriers, one was fixed for a weakened barrier and two did not contain a barrier. Results are presented in Table 204.

Table 204. Results of evaluation for *Gal-m* resistance in 1222-2 crosses from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5637_PHP38xZ51.J78_1222-2_8348-1_316x298-i/13	100	8	y	Full
5917_N46xZ51.J78_1222-2_8348-1_301x298-j/13	21	6	n	Full
5464_PHN46xZ51.J78_1222-2_8348-301x299-i/13	999	8	y	Full
5918_N46xZ51.J78_1222-2_8348-2_301x299-j/13	50	8	n	Full
5481_PHN46xZ51.J78_1222-2_8348-3_301x300-i/13	999	7	n	None
5672_PHP38xZ51.J78_1222-2_8348-3_316x300-j/13	999	9	n	None
5793_296xZ51.J78_1222-2S2_299_8474x8411-a/13	75	9	n	Weak

1222-3

1222-3 is the result of a self from the third plant in row 1222 of the 2012 summer nursery, meaning it is another sampling of the original self that generated 1222-2. The F₂S₁ seed was planted ear-to-row and evaluated in isolation for resistance to pollination by *Gal-m*. Seven rows were found to be uniformly resistant to pollination, and one row was found to segregate for resistance to pollination, containing a mixture of bare and set ears within the row. Results are presented in Table 205.

Table 205. Results of evaluation for *Gal-m* resistance in 1222-2 F₂S₁s from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5401_PHZ51xJal78_F2S1_1222-03_284-1/13	6	9	n	Full
5402_PHZ51xJal78_F2S1_1222-03_284-2/13	85	5	y	Full-Weak
5403_PHZ51xJal78_F2S1_1222-03_284-3/13	5	8	n	Full

Table 205. Continued

Row Pedigree Source	# K	# Ears	Seg?	Type
5404_PHZ51xJal78_F2S1__1222-03_284-4/13	1	6	n	Full
5405_PHZ51xJal78_F2S1__1222-03_284-5/13	7	8	n	Full
5406_PHZ51xJal78_F2S1__1222-03_284-6/13	17	8	n	Full
5407_PHZ51xJal78_F2S1__1222-03_284-7/13	0	2	n	Full
5408_PHZ51xJal78_F2S1__1222-03_284-8/13	16	8	n	Full

The original F₁ crosses were backcrossed once to NC296, a *Gal-s*-containing inbred, and selfed twice. The resulting seed was planted ear-to-row in the 2014 *Gal-m* iso and evaluated for resistance to *Gal-m* pollination. Thirteen isolation rows, which were derived from two BC₁S₁ plants from the same row, were evaluated, resulting in 12 isolation rows classified as resistant to pollination, and one row for which inadequate data was present to be able to determine pollination resistance. Results are presented in Table 206.

Table 206. Results of evaluation for *Gal-m* resistance in 1222-3 BCS₂s from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5528_NC296*2xZ51.Jal78_1222-3_wBCS2_8318-1/13	0	7	n	Full
5529_NC296*2xZ51.Jal78_1222-3_wBCS2_8318-2/13	0	7	n	Full
5530_NC296*2xZ51.Jal78_1222-3_wBCS2_8318-3/13	0	6	n	Full
5531_NC296*2xZ51.Jal78_1222-3_wBCS2_8318-4/13	0	7	n	Full
5532_NC296*2xZ51.Jal78_1222-3_wBCS2_8318-5/13	5	7	n	Full
5533_NC296*2xZ51.J78_1222-3BCS2_8319-1/13	0	6	n	Full
5535_NC296*2xZ51.J78_1222-3BCS2_8319-3/13	0	8	n	Full
5536_NC296*2xZ51.J78w1222-3BCS2_8319-4/13	10	7	n	Full

Table 206. Continued

Row Pedigree Source	# K	# Ears	Seg?	Type
5537_NC296*2xZ51.J78w1222-3BCS2_8319-5/13	25	1	?	?
5538_NC296*2xZ51.J78w1222-3BCS2_8319-6/13	0	8	n	Full
5539_NC296*2xZ51.J78w1222-3BCS2_8319-7/13	0	7	n	Full
5540_NC296*2xZ51.J78_1222-3BCS2_8319-8/13	0	5	n	Full

BC₃s (plots 5661, 5662) and one BC₂S₁ (plot 5527) were developed by backcrossing to NC296. These were evaluated for resistance to pollination by *Gal-m*, and one BC₃ was found to segregate for resistance to pollination, while the other row was fully set, indicating resistance had been lost through backcrossing or segregation. The BC₂S₁ was found to segregate between full-strength, weakened and no barrier within row. Results are presented in Table 207.

Table 207. Results of evaluation for *Gal-m* resistance in 1222-3 backcrosses from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5527_NC296*3xZ51.J78_1222-3BC2S1_8317-3/13	500	8	y	Full-Weak-None
5662_NC296*4xZ51.J78_1222-3_8474x73-5/13	999	8	n	None
5661_NC296*4xZ51.J78_1222-3_8474x73-1/13	100	8	y	Full-Weak-None

1223-1

The 1223 family of crosses are derived from a cross between PHZ51 and Jalisco 78, although they likely originate from a different individual Jalisco 78 plant than the 1222 families, which could contain vastly different alleles due to the often heterogeneous nature of accessions. F₂S₁ seed of this cross were planted ear-to-row in isolation rows and evaluated for resistance to *Gal-m* pollination. Of the six isolation rows evaluated, two were found to have full strength blockage (rows 5343 and 5344) although row 5344 flowered very late, meaning this data point may not be an accurate representation. An additional two isolation rows were found to segregate for resistance to pollination by *Gal-m* within row. One row did not have resistance to pollination by *Gal-m* and had well set ears when evaluated. One row, 5342, had uniformly reduced seed set, indicating the presence of a weakened barrier acting within this row. Results are presented in Table 208.

Table 208. Results of evaluation for *Gal-m* resistance in 1223-1 F₂S₁s from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5341_PHZ51xJal78su__1223-01_F2S1____8349-1/12	30	8	y	Full
5342_PHZ51xJal78su__1223-01_F2S1____8349-2/12	45	6	n	Weak
5343_PHZ51xJal78su__1223-01_F2S1____8349-3/12	15	6	n	Full
5344_PHZ51xJal78su__1223-01_F2S1____8349-4/12	0	3	n	Late
5345_PHZ51xJal78su__1223-01_F2S1____8349-5/12	67	9	y	Full
5346_PHZ51xJal78su__1223-01_F2S1____8349-6/12	500	4	n	None

F₂S were selfed to make F₂S₁S which were again selfed, and this seed was also entered into evaluation for resistance to *Gal-m* pollination. Seed from two individual F₂ plants was used, with rows 5474-5478 being derived from the source of row 5341, which segregated for a full strength barrier, and rows 5479 and 5480 being derived from the source of row 5343, which appeared to be resistant to *Gal-m* pollination. Evaluation of plants derived from the 5341 source exhibited a mixture of pollen-blocking actions, with only one row, 5478, appearing to contain a full strength barrier, and the number of harvested ears prevents being able to definitively say that it did not segregate. One row segregated for a full strength barrier within the isolation row, containing a mix of set and bare ears. One row uniformly contained a weakened barrier, while another segregated for a weakened barrier, containing a mixture of full and weakly set ears. Interestingly, one row, 5477, segregated between a full-strength barrier and a weakened barrier, containing a mix of weakly set and bare ears within the row. From rows derived from the second source, one contained a full strength barrier, while the other segregated between a full barrier and a weakened barrier, containing a mixture of bare and weakly set ears within row. Results are presented in Table 209.

Table 209. Results of evaluation for *Gal-m* resistance in 1223-1 F₂S₁S from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5474_PHZ51xJal78_1223-01/12_F2S1__321-1/13	45	5	n	Weak
5475_PHZ51xJal78_1223-01/12_F2S1__321-2/13	61	11	y	Full
5476_PHZ51xJal78_1223-01/12_F2S1__321-3/13	250	7	y	Weak
5477_PHZ51xJal78_1223-01/12_F2S1__321-4/13	170	6	y	Full-Weak
5478_PHZ51xJal78_1223-01/12_F2S1__321-5/13	26	3	n	Full

Table 209. Continued

Row Pedigree Source	# K	# Ears	Seg?	Type
5479_PHZ51xJal78_1223-01/12_F2S1__323-1/13	8	4	n	Full
5480_PHZ51xJal78_1223-01/12_F2S1__323-2/13	52	4	y	Full-Weak

Plants from the source of row 5474 were selfed, planted ear-to-row and selfed again, resulting in six individually numbered ears. This F₂S₃ seed was entered into evaluation and all six of the isolation rows were resistant to pollination by *Gal-m*, and did not segregate within row. Results are presented in Table 210.

Table 210. Results of evaluation for *Gal-m* resistance in 1223-1 F₂S₃S from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5628_PHZ51xJal78_1223-01/12_F2S3_8413-1/13	4	2	n	Full
5629_PHZ51xJal78_1223-01/12_F2S3_8413-2/13	0	4	n	Full
5630_PHZ51xJal78_1223-01/12_F2S3_8413-3/13	11	4	n	Full
5631_PHZ51xJal78_1223-01/12_F2S3_8413-4/13	12	9	n	Full
5632_PHZ51xJal78_1223-01/12_F2S3_8413-5/13	12	8	n	Full
5633_PHZ51xJal78_1223-01/12_F2S3_8413-6/13	10	7	n	Full

The original F₂ plant was crossed and backcrossed to PHN46, an inbred with no known gametophyte factors, for various numbers of cycles, and these were evaluated for resistance to pollination by *Gal-m*. A BC₂S₁ was planted ear-to-row and selfed as individually

numbered plants to produce BC₂S₂ seed, which was entered into evaluation for resistance to pollination by *Gal-m* (rows 5598-5603). Evaluation resulted in no non-segregating rows. Two rows had weakened barriers that were uniform, although the kernel counts for these were higher than other “weak” barriers. Three rows segregated between weak and full barriers, having a mix of bare and weakly set ears within the row. BC₃S₁s (rows 5586-5591) were also developed from the same BC₂ source as the BC₂S₂s, and were evaluated, resulting in one row completely losing the resistance, and producing fully set ears. The other five rows evaluated resulted in two segregating for full-strength barriers, one segregating for a weak barrier, one segregating between full and weak barrier action, and, interestingly, one row contained plants appearing to have no barrier, plants with a weak barrier and plants with a full barrier. BC₄s (rows 5663-5664) were also developed from the same BC₂ source, and evaluation showed one segregating for a weak barrier and one segregating for a full barrier, although the number of plants not fully set was one within each row. One F₂S₁ was crossed to NC296, an inbred containing *Gal-s*, which resulted in a line segregating for a weak barrier. Results are presented in Table 211.

Table 211. Results of evaluation for *Gal-m* resistance in 1223-1 BCS₂s from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5598_PHN46*2xZ51.J78_1223-1_BCS2_8330-1/13	85	8	n	Weak
5599_PHN46*2xZ51.J78_1223-1_BCS2_8330-2/13	100	6	n	Weak
5600_PHN46*2xZ51.J78_1223-1_BCS2_8330-3/13	800	6	y	Weak
5601_PHN46*2xZ51.J78_1223-1_BCS2_8330-4/13	85	6	y	Full-Weak
5602_PHN46*2xZ51.J78_1223-1_BCS2_8330-5/13	50	5	y	Full-Weak

Table 211. Continued

Row Pedigree Source	# K	# Ears	Seg?	Type
5603_PHN46*2xZ51.J78_1223-1_BCS2__8330-6/13	30	8	y	Full-Weak
5586_PHN46*3xZ51.J78_1223-1BC2S1__8328-1/13	999	6	n	None
5587_PHN46*3xZ51.J78_1223-1BC2S1__8328-2/	700	7	y	Full
5588_PHN46*3xZ51.J78_1223-1BC2S1__8328-3/13	800	8	y	Full-Weak
5589_PHN46*3xZ51.J78_1223-1BC2S1__8328-4/13	999	9	y	Full
5590_PHN46*3xZ51.J78_1223-1BC2S1__8328-5/13	999	7	y	Weak
5591_PHN46*3xZ51.J78_1223-1BC2S1__8328-6/13	550	7	y	Full-Weak-None
5664_PHN46*4xZ51.J78_1223-1_002_8486x85-5/13	600	6	y	Weak
5663_PHN46*4xZ51.J78_1223-1_008_8486x85-2/13	600	5	y	Full
5794_296xZ51.J78_1223-1S2__8474x8413-a/13	55	8	n	Weak

1223-2

1223-2 lines are derived identically to 1223-1, with 1223-2 simply being the second plant within the same original row as 1223-1. This cross between PHZ51 and Jalisco 78 was advanced to the F₂ and this seed was entered into evaluation for resistance to *Gal-m* pollination. Of the six F₂S₁S evaluated, three contained a weak barrier, one had full barrier strength, and one segregated between weak and full within row. An additional one flowered late and was likely not pollinated. Due to limited experimental space, additional material from this source was not included. Results are presented in Table 212.

Table 212. Results of evaluation for *Gal-m* resistance in 1223-2 F₂S₁s from Jalisco 78

Row	Pedigree	Source		# K	# Ears	Seg?	Type	
5347	PHZ51xJal78	1223-02	F2S1	8358-1/12	80	8	n	Weak
5348	PHZ51xJal78	1223-02	F2S1	8358-2/12	0	5	n	Late
5349	PHZ51xJal78	1223-02	F2S1	8358-3/12	21	9	y	Full-Weak
5350	PHZ51xJal78	1223-02	F2S1	8358-4/12	46	7	n	Weak
5351	PHZ51xJal78	1223-02	F2S1	8358-5/12	19	4	n	Weak
5352	PHZ51xJal78	1223-02	F2S1	8358-6/12	8	6	n	Full

1223-6

1223-6 was derived in a similar manner as 1223-2, and resulted from the sixth plant in the original row. Of the six F₂S₁s evaluated, two did not segregate for a full-strength barrier, one segregated within row for a full strength barrier, one segregated for a weakened barrier, and one segregated between full-strength and weakened barrier strength. One additional row (5354) segregated between all three barrier conditions, containing one bare ear, and a mix of poor and fully set ears. No additional material from this source was included. Results are presented in Table 213.

Table 213. Results of evaluation for *Gal-m* resistance in 1223-6 F₂S₁s from Jalisco 78

Row	Pedigree	Source		# K	# Ears	Seg?	Type	
5353	PHZ51xJal78	1223-06	F2S1	8359-1/12	55	9	y	Full-Weak

Table 213. Continued

Row Pedigree Source	# K	# Ears	Seg?	Type
5354_PHZ51xJal78____1223-06_F2S1_8359-2/12	280	8	y	Full-Weak-None
5355_PHZ51xJal78__1223-06_F2S1__8359-3/12	49	9	y	Weak
5356_PHZ51xJal78__1223-06_F2S1__8359-4/12	0	7	n	Full
5357_PHZ51xJal78__1223-06_F2S1__8359-5/12	0	9	n	Full
5358_PHZ51xJal78r_1223-06_F2S1__8359-6/12	15	9	y	Full

1223-9

1223-9 derived F₂S₁s were similarly derived, and were entered into evaluation. This evaluation resulted in one row fixed for a full-strength barrier, and one row segregating between a full-strength and a weakened barrier to *Gal-m*. No additional material from this source was included in the study. Results are presented in Table 214.

Table 214. Results of evaluation for *Gal-m* resistance in 1223-9 F₂S₁s from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5359_PHZ51xJal78____1223-09_F2S1_8360-1/12	100	7	y	Full-Weak
5360_PHZ51xJal78__1223-09_F2S1__8360-2/12	0	5	n	Full

1223-10

1223-10 derived lines were derived similarly to 1223-1, but resulted from the tenth plant in the row. Of the six F₂S₁s evaluated, five segregated for weakened barriers, and one did not contain any barrier to pollination by *Gal-m*, containing fully set ears. Results are presented in Table 215.

Table 215. Results of evaluation for *Gal-m* resistance in 1223-10 F₂S₁s from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5361_PHZ51xJal78_1223-10_F2S1_8350-1/12	999	9	n	None
5362_PHZ51xJal78_1223-10_F2S1_8350-2/12	800	8	y	Weak
5363_PHZ51xJal78_1223-10_F2S1_8350-3/12	84	9	y	Weak
5364_PHZ51xJal78_1223-10_F2S1_8350-4/12	999	8	y	Weak
5365_PHZ51xJal78_1223-10_F2S1_8350-5/12	400	8	y	Weak
5366_PHZ51xJal78_1223-10_F2S1_8350-6/12	500	7	y	Weak

1223-10 was also crossed to 1274-1 twice, then selfed twice to produce S₂ seed, which was evaluated for resistance to pollination by *Gal-m*. Of the three evaluated, one contained a full strength barrier, one contained a no barrier, and one segregated between full and weakened within row. Results are presented in Table 216.

Table 216. Results of evaluation for *Gal-m* resistance in 1223-10 BCS_{2S} from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5577_1274-1*2xZ51.J78_1223-10_BCS2__8326-1/13	100	7	y	Full-Weak
5578_1274-1*2xZ51.J78_1223-10_BCS2__8326-2/13	500	7	n	None
5579_1274-1*2xZ51.J78_1223-10_BCS2__8326-3/13	1	6	n	Full

1226-1

The 1226 family of crosses are derived from a cross between PHZ51 and Jalisco 78, although likely from a different Jalisco 78 plant than the previous families. Seed from this cross was planted ear-to-row and selfed. Seed from these individual plants was entered into evaluation for resistance to pollination by *Gal-m*. Of the five screened, three contained weakened barriers, one contained no barrier, and one segregated between full and weakened barriers within row. Results are presented in Table 217.

Table 217. Results of evaluation for *Gal-m* resistance in 1226-1 F₂S_{1S} from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5409_PHZ51xJ78_F2S1_1226-01_285-1/13	600	7	y	Weak
5410_PHZ51xJ78_F2S1_1226-01_285-2/13	999	8	n	None
5411_PHZ51xJ78_F2S1_1226-01_285-3/13	150	5	n	Full-Weak
5412_PHZ51xJ78_F2S1_1226-01_285-4/13	600	6	n	Weak
5413_PHZ51xJ78_F2S1_1226-01_285-5/13	200	9	y	Weak

1226-6

1226-6 was derived similarly to the rest of the 1226 family of material, resulting from a self of the sixth individual F₂ plant within row of a cross between PHZ51 and Jalisco 78. Six F₂S₁s were evaluated for resistance to pollination, resulting in one fixed for a full-strength barrier, one segregating for a weakened barrier, three segregating between full-strength and weakened barrier within row. One was inconclusive due to only one ear being recovered. Results are presented in Table 229.

Table 229. Results of evaluation for *Gal-m* resistance in 1226-6 F₂S₁s from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5373_PHZ51xJ78___1226-06_F2S1___8357-1/12	125	9	y	Full-Weak
5374_PHZ51xJ78___1226-06_F2S1___8357-2/12	85	6	y	Full-Weak
5375_PHZ51xJ78___1226-06_F2S1___8357-3/12	250	8	y	Weak
5376_PHZ51xJ78___1226-06_F2S1___8357-4/12	0	3	n	Full
5377_PHZ51xJ78___1226-06_F2S1___8357-5/12	208	8	y	Full-Weak
5378_PHZ51xJ78___1226-06_F2S1___8357-6/12	9	1	?	?

1226-7

1226-7 was derived similarly to the rest of the 1226 family of material, resulting from a self of the seventh individual F₂ plant within row of a cross between PHZ51 and Jalisco 78. Six

F₂S₁s were evaluated for resistance to pollination by *Gal-m*, resulting in three segregating for a full-strength barrier, one segregating between full-strength and a weakened barrier, one segregating between all three barrier types within row. One row (5384) appeared to segregate for a full barrier, but flowered so late that adequate pollination could not be guaranteed.

Results are presented in Table 230.

Table 230. Results of evaluation for *Gal-m* resistance in 1226-7 F₂S₁s from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5379_PHZ51xJal78__1226-07_F2S1__8361-1/12	500	7	y	Full-Weak-None
5380_PHZ51xJal78__1226-07_F2S1__8361-2/12	250	6	y	Full
5381_PHZ51xJal78__1226-07_F2S1__8361-3/12	400	9	y	Full-Weak
5382_PHZ51xJal78__1226-07_F2S1__8361-4/12	140	8	y	Full
5383_PHZ51xJal78__1226-07_F2S1__8361-5/12	45	6	y	Full
5384_PHZ51xJal78__1226-07_F2S1__8361-6/12	2	5	n	Full/Late

1226-8

1226-8 was derived similarly to the rest of the 1226 family of material, resulting from a self of the eight individual F₂ plant within row of a cross between PHZ51 and Jalisco 78. Six F₂S₁s were evaluated for resistance to pollination by *Gal-m*, resulting in three segregating for a full-strength barrier, one segregating between full-strength and weakened barriers, and two did not contain a barrier. Results are presented in Table 231.

Table 231. Results of evaluation for *Gal-m* resistance in 1226-8 F₂S₁s from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5424_PHZ51xJ78_F2S1____1226-08____288-1/13	999	8	n	None
5425_PHZ51xJ78_F2S1____1226-08____288-2/13	999	7	y	Full
5426_PHZ51xJ78_F2S1____1226-08____288-3/13	600	6	y	Full
5427_PHZ51xJ78_F2S1____1226-08____288-4/13	300	8	n	None
5428_PHZ51xJ78_F2S1____1226-08____288-5/13	117	8	y	Full
5429_PHZ51xJ78_F2S1____1226-08____288-6/13	75	6	y	Full-Weak

The source of row 5424 was selfed once again to produce F₂S₂s which were evaluated, resulting in one row segregating for a full-strength barrier, two segregating for a weakened barrier, and two fixed for a weakened barrier. This may indicate that row 5424 was a false negative and must contain some resistance to pollination by *Gal-m*, or experimental error is possible. Results are presented in Table 232.

Table 232. Results of evaluation for *Gal-m* resistance in 1226-8 F₂S₂s from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5642_PHZ51xJ78____1226-8_F2S2_8416-1/13	100	8	y	Weak
5643_PHZ51xJ78____1226-8_F2S2_8416-2/13	200	9	y	Weak
5644_PHZ51xJ78____1226-8_F2S2_8416-3/13	150	8	n	Weak
5645_PHZ51xJ78____1226-8_F2S2_8416-4/13	85	5	n	Weak
5646_PHZ51xJ78____1226-8_F2S2_8416-5/13	23	3	y	Full

1226-9

1226-9 was derived similarly to the rest of the 1226 family of material, resulting from a self of the ninth plant individual F₂ plant within row of a cross between PHZ51 and Jalisco 78. Five F₂S₁s were evaluated for resistance to pollination by *Gal-m*, resulting in one fixed for a full-strength barrier, one segregating for a full-strength barrier, one segregating for a weakened barrier, and two segregating between all three barrier types within row. One row (5388) appeared to segregate for a full-strength barrier, but flowered so late that adequate pollination could not be guaranteed. Results are presented in Table 233.

Table 233. Results of evaluation for *Gal-m* resistance in 1226-8 F₂S₁s from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5385_PHZ51xJal78__1226-09_F2S1__8362-1/12	117	6	y	Full-Weak-None
5386_PHZ51xJal78__1226-09_F2S1__8362-2/12	250	8	y	Weak
5387_PHZ51xJal78__1226-09_F2S1__8362-3/12	200	8	y	Full
5388_PHZ51xJal78__1226-09_F2S1__8362-4/12	13	5	y	Full/Late
5389_PHZ51xJal78__1226-09_F2S1__8362-5/12	400	8	y	Full-Weak-None
5390_PHZ51xJal78__1226-09_F2S1__8362-6/12	2	8	n	Full

1161-5

1161-5 was derived by crossing NC320xNC368, a single cross hybrid with no known gametophyte factors, with Jalisco 78. These were selfed twice to produce F₂S₁s, which were

evaluated for resistance to pollination by *Gal-m*, resulting in one fixed for a full-strength barrier, one fixed for a weak barrier, and two flowering so late that adequate pollination could not be guaranteed. Results are presented in Table 234.

Table 234. Results of evaluation for *Gal-m* resistance in 1161-5 F₂S₁s from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5303_320.368xJ78_1161-05_F2S1_8346-1/12	xxx	xxx	xxx	Late
5304_320.368xJ78_1161-05_F2S1_8346-2/12	700	6	n	Weak
5305_320.368xJ78_1161-05_F2S1_8346-3/12	0	6	n	Full/Late
5306_320.368xJ78_1161-05_F2S1_8346-4/12	8	7	n	Full

F₂s were then selfed twice to produce F₂S₂s, which were evaluated for resistance to pollination. These represent selfs on two individual F₂S₁ plants, with rows 5439-5444 representing selfs within row of one plant, and row 5445 representing a self of a sister F₂S₁ as the others. Of these six lines from the first source, two segregated for a full-strength barrier, three were fixed for a weakened barrier, and one segregated between a full-strength and weakened barrier. The line from the other source did not appear to contain a barrier. Results are presented in Table 235.

Table 235. Results of evaluation for *Gal-m* resistance in 1161-5 F₂S₂S from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5439_320.368xJ78__1161-05/12_F2S2__293-1/13	999	5	n	Weak
5440_320.368xJ78__1161-05/12_F2S2__293-2/13	999	7	y	Full-Weak
5441_320.368xJ78__1161-05/12_F2S2__293-3/13	400	6	n	Weak
5442_320.368xJ78__1161-05/12_F2S2__293-4/13	80	7	n	Weak
5443_320.368xJ78__1161-05/12_F2S2__293-5/13	125	5	y	Full
5444_320.368xJ78__1161-05/12_F2S2__293-6/13	30	3	y	Full
5445_320.368xJ78__1161-05_F2S2__294-1/13	100	3	n	None

1179-2

1179-2 was derived by crossing Jalisco 78 as male to NC476xHBA1, a single cross hybrid with no known gametophyte factors. These were then selfed twice to produce F₂S₁S, which were evaluated for resistance to pollination by *Gal-m*. Of the three evaluated, one segregated for a weakened barrier, and the other two only yielded one ear each, so no determination of barrier type was possible. Results are presented in Table 236.

Table 236. Results of evaluation for *Gal-m* resistance in 1179-2 F₂S₁S from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5319_NC476.HBA1xJ78__1179-02_F2S1__8356-1/12	500	7	y	Weak
5320_NC476.HBA1xJ78__1179-02_F2S1__8356-2/12	25	1	n	?
5321_NC476.HBA1xJ78__1179-02_F2S1__8356-3/12	999	1	n	?

1214-5

1214-5 was derived by crossing Jalisco 78 as male to NC476xHBA1, a single cross hybrid with no known gametophyte factors. These were then selfed twice to produce F₂S₁s, which were evaluated for resistance to pollination by *Gal-m*, resulting in one fixed for a full-strength barrier, one segregating for a full-strength barrier, one segregating for a weakened barrier and one segregating between all three barrier types within row. Two were unable to be determined, one because no ears were recovered to evaluate and another flowered so late that adequate pollination could not be guaranteed. Results are presented in Table 237.

Table 237. Results of evaluation for *Gal-m* resistance in 1179-2 F₂S₁s from Jalisco 78

Row Pedigree Source	# K	# Ears	Seg?	Type
5323_476.HBA1xJ78_1214-05_F2S1___8347-1/12	500	8	y	Full-Weak-None
5325_476.HBA1xJ78_1214-05_F2S1___8347-3/12	50	7	y	Full
5326_476.HBA1xJ78_1214-05_F2S1___8347-4/12	9	6	n	Full
5327_476.HBA1xJ78_1214-05_F2S1___8347-5/12	49	6	y	Late
5328_476.HBA1xJ78_1214-05_F2S1___8347-6/12	500	7	y	Weak

3801

The 3801 family of material was obtained from original crosses by the GEM program and was derived from a cross between B47 and Jalisco 78, selfed once which was then

crossed to NC368. The resulting seed was entered into evaluation resulting in one segregating for a weakened barrier, one segregating for all three barrier types within row, and twenty-three containing no barrier. Results are presented in Appendix I Table 25. Three lines were crossed to NC320 or T39 as a substitute for NC368, and resulted in three containing no barrier, and one segregating for a weakened barrier. 3801-3 was additionally backcrossed once to B47, resulting in a line that segregated for a full-strength barrier within row. Results are presented in Appendix I Table 26.

Several lines were developed from a second crossing with Jalisco 78 possibly sampling different alleles from the original population. For these, Jalisco 78 was crossed as male to LH132, which was then crossed to NC368 twice and entered into evaluation for resistance to *Gal-m*. Of three evaluated, two appeared to segregate for a weakened barrier, and one did not contain a barrier. Results are presented in Appendix I Table 27. Two crosses of LH132 and Jalisco 78 were evaluated directly for resistance to pollination. Of these two, one segregated for a weakened barrier and one did not contain a barrier. Results are presented in Appendix I Table 28. Seed from five other crosses of Jalisco 78 to various standard lines were also entered into evaluation. None of this material contained a barrier to *Gal-m*. Results are presented in Appendix I Table 29.

Jalisco 300

1228-2

1228-2 was derived by crossing Jalisco 300 as male to NC476xHBA1, a hybrid with no

known gametophyte factors, and then selfing twice to produce F₂S₁s. These F₂S₁s were evaluated for resistance to pollination by *Gal-m*, resulting in one fixed for a full-strength barrier, two segregating for a full strength barrier, and two that could not be properly determined due to late flowering dates. Results are presented in Table 238.

Table 238. Results of evaluation for *Gal-m* resistance in 1228-2 F₂S₁s from Jalisco 300

Row Pedigree Source	# K	# Ears	Seg?	Type
5391_476.HBA1xJal300_1228-02_F2S1_8363-1/12	25	6	n	Full/Late
5392_476.HBA1xJal300_1228-02_F2S1_8363-2/12	85	8	y	Full
5393_476.HBA1xJal300_1228-02_F2S1_8363-3/12	30	5	y	Full
5394_476.HBA1xJal300_1228-02_F2S1_8363-4/12	10	5	n	Late
5395_476.HBA1xJal300_1228-02_F2S1_8363-5/12	0	8	n	Full

The source of row 5391 was once again selfed to produce F₂S₂s. Unfortunately, the resulting rows all flowered late so that adequate pollination could be guaranteed, meaning that these three rows were not conclusive. However, one did appear to be fixed for a full-strength barrier, but it is possible that this is due to not being pollinated. Results are presented in Table 239.

Table 239. Results of evaluation for *Gal-m* resistance in 1228-2 F₂S₂S from Jalisco 300

Row Pedigree Source	# K	# Ears	Seg?	Type
5492_476.HBA1xJ300_1228-02/12_F2S2_328-1/13	17	5	n	Full/Late
5494_476.HBA1xJ300_1228-02/12_F2S2_329-1/13	0	1	n	Late
5495_476.HBA1xJ300_1228-02/12_F2S2_329-2/13	0	1	n	Late

The F₂S were also crossed to NC476 and NC474, lines with no known gametophyte factors, resulting in one segregating for a full strength barrier and three containing no barrier to *Gal-m* at all. The F₂ was also crossed to NC296, a line containing *Gal*, which resulted segregation for all three barrier types within row. Results are presented in Table 240.

Table 240. Results of evaluation for *Gal-m* resistance in 1228-2 F₂ crosses from Jalisco 300

Row Pedigree Source	# K	# Ears	Seg?	Type
5795_296x476.HBA1.J300_1228-2w_8474x8081-a/13	400	6	y	Full-Weak-None
5796_474x476.HBA1.J300_1228-02_8447x8081-a/13	999	8	y	Full
5797_476x476.HBA1/J300_1228-02_8499x8081-a/13	800	7	n	None
5798_476x476.HBA1/J300_1228-02_8499x8081-b/13	999	7	n	None
5799_N46x476/HBA1.J300_1228-2_8387x8081-a/13	999	8	n	None

1229-5

1229-5 was derived by crossing Jalisco 300 as male to NC476xHBA1, a hybrid with no

known gametophyte factors, then selfed twice to produce F₂S₁S, which were evaluated for resistance to pollination by *Gal-m*. Of the two evaluated, one did not contain a barrier, and the other, although appearing to contain a full-strength barrier, was so late that it may not have been properly pollinated. Results are presented in Table 241.

Table 241. Results of evaluation for *Gal-m* resistance in 1229-5 F₂S₁S from Jalisco 300

Row Pedigree Source	# K	# Ears	Seg?	Type
5396_476.HBA1xJ300_F2S1_____1229-05_281-1/13	0	4	n	Late
5397_476.HBA1xJ300_F2S1_____1229-05_281-2/13	400	4	n	None

1231-2

1231-2 was derived by crossing Jalisco 300 as male to NC476xHBA1, a hybrid with no known gametophyte factors, then selfing twice to produce F₂S₁S, which were evaluated for resistance to pollination by *Gal-m*. Of the four evaluated, two segregated for a full-strength barrier, and two flowered so late that adequate pollination could not be guaranteed. Results are presented in Table 242.

Table 242. Results of evaluation for *Gal-m* resistance in 1231-2 F₂S₁s from Jalisco 300

Row Pedigree Source	# K	# Ears	Seg?	Type
5430_476.HBA1xJ300__F2S1__1231-02__290-1/13	6	7	n	Late
5431_476.HBA1xJ300__F2S1__1231-02__290-2/13	46	4	y	Full/Late
5432_476.HBA1xJ300__F2S1__1231-02__290-3/13	105	7	y	Full
5433_476.HBA1xJ300__F2S1__1231-02__290-4/13	50	7	y	Full

1231-4

1231-4 was derived by crossing Jalisco 300 as male to NC476xHBA1, a hybrid with no known gametophyte factors, then selfing twice to produce F₂S₁s, which were evaluated for resistance to pollination by *Gal-m*. Of the four evaluated, one segregated for a full-strength barrier, one segregated for a weakened barrier, one segregated between full-strength and weakened barriers within row, and one flowered so late that adequate pollination could not be guaranteed. Results are presented in Table 243.

Table 243. Results of evaluation for *Gal-m* resistance in 1231-4 F₂S₁s from Jalisco 300

Row Pedigree Source	# K	# Ears	Seg?	Type
5434_476.HBA1xJ300__F2S1__1231-04__291-1/13	250	4	y	Full-Weak
5435_476.HBA1xJ300__F2S1__1231-04__291-2/13	201	2	y	Full
5436_476.HBA1xJ300__F2S1__1231-04__291-3/13	209	5	y	Full/Late
5437_476.HBA1xJ300__F2S1__1231-04__291-4/13	500	6	y	Weak

to CS405 then to ICI986 then to NC368 twice, then selfed once, and this seed was evaluated for resistance to pollination by *Gal-m*. Of the twelve evaluated, only one segregated for a weak barrier, and the remaining eleven did not contain a barrier to *Gal-m*. Results are presented in Appendix I Table 30. From the same original F₂ of the PHB47xJalisco304 cross, lines were developed by crossing to CS405 then to ICI986 then to NC368, and then selfed once, and this seed was evaluated for resistance to pollination by *Gal-m*. Of the twelve evaluated, three segregated for a weakened barrier, three segregated for all three barrier types, and six did not contain a barrier to *Gal-m*. Results are presented in Appendix I Table 31.

1170-8

1170-8 was derived by crossing Jalisco 304 as male to NC320xNC368, a hybrid with no known gametophyte factors, and then selfing twice to produce F₂S₁s, which were evaluated for resistance to pollination by *Gal-m*. Of the six evaluated, none contained a barrier, all having well set ears. Results are presented in Appendix I Table 32.

1172-3

1172-3 was derived by crossing Jalisco 304 as male to NC320xNC368, a hybrid with no known gametophyte factors, and then selfing twice to produce F₂S₁s, which were evaluated for resistance to pollination by *Gal-m*. Of the six evaluated, none contained a barrier, all having well set ears. Results are presented in Appendix I Table 33.

1173-4

1173-4 was derived by crossing Jalisco 304 as male to NC320xNC368, a hybrid with no known gametophyte factors, and then selfing three times to produce F₂S₂S, which were evaluated for resistance to pollination by *Gal-m*. Of the four evaluated, one segregated between all three barrier types and three did not contain a barrier. Results are presented in Appendix I Table 34.

Zacatecas 182

1341-5 and 1411

1341-5 was derived by crossing Zacatecas 182 as male to NC476, then backcrossing once to NC476 to produce BC₁S. These were evaluated for resistance to pollination by *Gal-m*. Of the two evaluated, one segregated for a weakened barrier and one did not contain a barrier. 1411-3 was derived by crossing Zacatecas 182 as male to LH165 then selfing twice to produce F₂S₁S, which were evaluated for resistance to pollination by *Gal-m*. Of the two evaluated, neither contained a barrier. 1411-6 was derived by crossing Zacatecas 182 as male to ICI581, then crossing to NC476. This seed was evaluated for resistance to pollination by *Gal-m*. Of the four evaluated, one segregated for a weakened barrier and three did not contain a barrier. 1411-9 was derived by crossing Zacatecas 182 as male to ICI581, then to NC476. This seed was evaluated for resistance to pollination by *Gal-m*, but neither of the two evaluated segregated for a barrier. 1411-11 was derived by crossing Zacatecas 182 as male to LH216, then crossing to HBA1. This seed was evaluated for resistance to pollination, but of the four

BC₂S₁s, which were also evaluated. Of the six evaluated, two segregated for a full-strength barrier, and four did not contain a barrier. Results are presented in Table 248.

Table 248. Results of evaluation for *Gal-m* resistance in 1411-13 BC₂S₁s from Zacatecas 182

Row Pedigree Source	# K	# Ears	Seg?	Type
5580_PHN46*3xZac182_1411-13BC2S1__8327-1/13	800	6	n	None
5581_PHN46*3xZac182_1411-13BC2S1__8327-2/13	999	6	n	None
5582_PHN46*3xZac182_1411-13BC2S1__8327-3/13	999	7	n	None
5583_PHN46*3xZac182_1411-13BC2S1__8327-4/13	85	5	y	Full
5584_PHN46*3xZac182_1411-13BC2S1__8327-5/13	999	8	n	None
5585_PHN46*3xZac182_1411-13BC2S1__8327-6/13	80	8	y	Full

3807

The 3807 family of material was derived by crossing Zacatecas 182 as male to PHB47 then selfing to produce F₂s in the summer of 2012, which were evaluated for resistance to pollination by *Gal-m*. Of the two evaluated, one appeared fixed for a weakened barrier and one segregated for a weakened barrier. Results are presented in Table 248.

Table 249. Results of evaluation for *Gal-m* resistance in 3807 F₂S₁s from Zacatecas 182

Row Pedigree Source	# K	# Ears	Seg?	Type
5844_B47/Maiz_Dulce-ZAC182__F2S1_3807-4/12	60	4	n	Weak
5845_B47/Maiz_Dulce-ZAC182__F2S1_3807-5/12	300	6	y	Weak

The material was then crossed to various standard lines and evaluated for resistance to *Gal-m*, but no barriers were observed in the evaluated material. Results are presented in Appendix I Table 36.

9539 and 9540

The 9539 family of material was derived by crossing the same row of Zacatecas 182 as male to various standard lines. This material was evaluated for resistance to pollination but no barriers were observed. The 9540 family of material was derived by crossing the same row of Zacatecas 182 as male to various standard lines. This material was evaluated for resistance to pollination by *Gal-m*, resulting in one row segregating for a full-strength barrier, one row segregating for a weakened barrier, and one row segregating between all three barrier types within row. Results are presented in Appendix I Table 37.

Zacatecas 40

Zacatecas 40 materials were derived by crossing and backcrossing to various standard lines to evaluate for resistance to pollination. Of the thirty-two individual lines evaluated, three segregated for a weakened barrier, and the remainder did not contain barriers to pollination.

Of the three that segregated within row, these types were very weak and were not frequent within row. Results are presented in Appendix I Table 38.

Guanajuato 100

9529 and 9530

The 9529 family of material was derived by crossing Guanajuato 100 as male to various standard lines to evaluate for resistance to pollination by *Gal-m*. Of the twelve evaluated, four segregated for weakened barriers and the remainder did not contain barriers. The 9530 family of material was derived by crossing Guanajuato 100 as male to various standard lines to evaluate for resistance to pollination by *Gal-m*. Of the seven evaluated one segregated for a full-strength barrier, two segregated for weakened barriers, and four did not contain a barrier. Results are presented in Appendix I Table 39.

Guanajuato 141

9531 and 9532

The 9531 family of material was derived by crossing Guanajuato 141 as male to various standard lines to evaluate for resistance to pollination by *Gal-m*. Of the nineteen evaluated, two segregated for full-strength barriers, one segregated for a weakened barrier, one segregated between full-strength and weakened barriers within row. One other segregated between all three barrier types within row, and one was undeterminable due to no ears being recovered. The remaining thirteen did not contain barriers. The 9532 family of material was

derived by crossing Guanajuato 141 as male to various standard lines to evaluate for resistance to pollination by *Gal-m*. Of the sixteen evaluated, seven segregated for weakened barriers and nine did not segregate for a barrier. Results are presented in Appendix I Table 40.

Guanajuato 181

9533

The 9533 family of material was derived by crossing Guanajuato 181 as male to various standard lines to evaluate for resistance to pollination by *Gal-m*. Of the fifteen lines evaluated, one segregated for a full-strength barrier, five segregated for a weakened barrier, and nine did not contain a barrier. The 9534 family of material was derived by crossing Guanajuato 181 as male to various standard lines to evaluate for resistance to pollination by *Gal-m*. Of the ten evaluated, one segregated for a full-strength barrier, five segregated for a weakened barrier, and four did not contain a barrier. Results are presented in Appendix I Table 41.

Michoacán 412

Michoacán 412 material was derived by crossing Michoacán 412 from three separate rows as male to various lines during winter nursery 2013, the seed of which was evaluated for resistance to pollination by *Gal-m*. Of the eleven evaluated, three were fixed for a weakened barrier, four segregated for a weakened barrier, three contained no barrier, and one was inconclusive, due to flowering so late that adequate pollination could not be guaranteed.

evaluated. A second sample of Jalisco 78 obtained through the GEM program (3801) from CIMMYT showed far less frequent resistance to *Gal-m* pollination, with some level of resistance occurring in only four of twenty-nine (13.7%) crosses with the accession (Appendix I Table 29). This disparity between the samplings of material clearly shows the need for extensive sampling to be able to adequately determine the frequency of resistance in a given accession, as well as highlights the need for better maintenance of our germplasm resources. It should also be noted that this screen comes from a rather restricted sample of diversity, and the frequency of resistance may differ in other populations and races.

Resistance to pollination by *Gal-m* generally occurs in two types: full-strength and weakened. Full-strength barriers block pollination uniformly, resulting in bare cobs, similar in appearance to ears that have not been pollinated, as one might expect. The weakened barrier types have notably reduced seed set, compared to full ears, but appear to do so in a uniform manner. These ears appear poorly set, as if systematically reduced, as opposed to poorly pollinated. The resistance system, in its full-strength and weakened blockage, resembles the *Gal* system of full-strength and weakened barriers to *gal* pollination.

The resistance to *Gal-m* pollination is quite clearly heritable, as the data show, and successive generations of selfing produced sets of lines fixed for full-strength resistance to *Gal-m* pollination. From 1223-1, resistant lines were developed through selfing, eventually fixing for full-strength resistance to pollination (Table 209). From lines where several generations of derived material were simultaneously evaluated, resistance to *Gal-m* is also shown to be continually heritable. In 1226-4, for example, F₂S₁S contained two lines that

were advanced, one of which segregated between full-strength and weakened barriers and one which segregated for a full-strength barrier (Table 219). The former, when selfed, and planted ear-to-row in three rows, produced one row segregating for a weakened barrier, one row fixed for a full-strength barrier, and one row that did not contain a barrier at all (Table 220). The latter row was similarly selfed and planted into three rows, of which two segregated for a full-strength barrier and one uniformly contained a full-strength barrier. From this two things are shown. First, that selfing of a row segregating for a full-strength barrier produces segregation for full strength barriers, fixing some of those individuals as resistant. The barrier strength of these rows is also shown to increase from the selfing, reducing the number of set seed found on each row. The second is that selfing rows segregating between full-strength barriers and weakened barriers can result in rows containing no barrier at all, meaning that the trait may be additive, complicating purification of lines. Once lines have been identified as fixed for a full-strength barrier, these lines appear to be successfully maintained by selfing.

In sets of material where backcrossing occurred, the process often weakened the resistance to *Gal-m* pollination. For example, the 1223-1 set of materials produced several rows completely resistant to pollination by *Gal-m*, but backcrosses derived from the same material appeared to weaken with each successive backcross, but not completely disappear (Table 210). In BC₂S₂s, the rows segregated for weakened barriers and between full-strength and weakened barriers, with low (<200 per row) seed set. BC₃S₁s and BC₄s produced more set seed per row, and some rows lost resistance to *Gal-m* pollination entirely. This suggests that

In general, there does not appear to be a connection between resistance to *gal* pollination and resistance to *Gal-m* pollination. In many cases plants resistant to *Gal-m* produced fully set ears when evaluated for resistance to *gal* pollination. In some cases, specifically 1222-2 derived lines, resistances occur together in some lines, meaning they are both resistant to *gal* and *Gal-m* pollination and therefore, could be a useful source of material for development of inbred lines containing both resistances (and evaluating very possible linkage between the two types of pollen blockage). We also see resistances occurring together in 1228-2 derived lines, but visual inspection of these lines in nursery indicate they may just be generally poor agronomically. The low occurrence of lines containing resistance to both *gal* and *Gal-m* pollination in our screen suggests that alleles for these two are unlinked, although systematic study of this is needed to be certain. Since *gal* resistance is allelic to *gal* (through the *Gal-s* system), the location of the *Gal-m* resistance alleles is likely elsewhere in the genome. This could be a secondarily-acquired resistance to *Gal-m* to overcome the promiscuous nature of the allele, and could have interesting implications on the relationship between maize and teosinte historically.

The identification of resistance to *Gal-m* allows potential to find out more about the *Gal-m* allele itself, such as if multiple types/strengths of *Gal-m* exist, as have been observed in *Gal-s* lines. It is entirely possible that multiple *Gal-m* alleles exist and that various alleles may require different resistances, a question that needs to be answered before a given source of *Gal-m* resistance is utilized to prevent non-target pollination. In this case, the question of multiple *Gal-m* resistances becomes quite important, and significantly complicates

APPENDICES

APPENDIX II

Table A2-1. Description of non-experimental material used

Material	Type
CML227	CIMMYT Inbred
HBA1	Ex-PVP Inbred
ICI581	Ex-PVP Inbred
LH132	Ex-PVP Inbred
LH165	Ex-PVP Inbred
LH181	Ex-PVP Inbred
LH51	Ex-PVP Inbred
P4639-1	P3737XNC492*2
PHN46	Ex-PVP Inbred
PHP38	Ex-PVP Inbred
PHT60	Ex-PVP Inbred
PHZ51	Ex-PVP Inbred
PHT11	Ex-PVP Inbred
PHV57	Ex-PVP Inbred
[NC320xNC368]	NC Hybrid
NC258	NC Inbred
NC296	<i>Gal</i> Inbred
NC320	NC Inbred
NC354	<i>Gal</i> Inbred
NC368	NC Inbred
NC390	<i>Gal-m</i> Inbred
NC394	<i>Gal-m</i> inbred
NC400	<i>Gal</i> Inbred
NC464	<i>Gal</i> Inbred
NC474	NC Inbred
NC476	NC Inbred
NC508	NC Inbred
NC520	<i>Gal</i> Inbred
NC522	<i>Gal</i> Inbred
[NC476xHBA1]	NCxPVP Hybrid
8213	P3737xNC320*3
1116-1	NC258*2xNC296 <i>gal</i> 1
1274-1	NC334x105.55/TZ70

